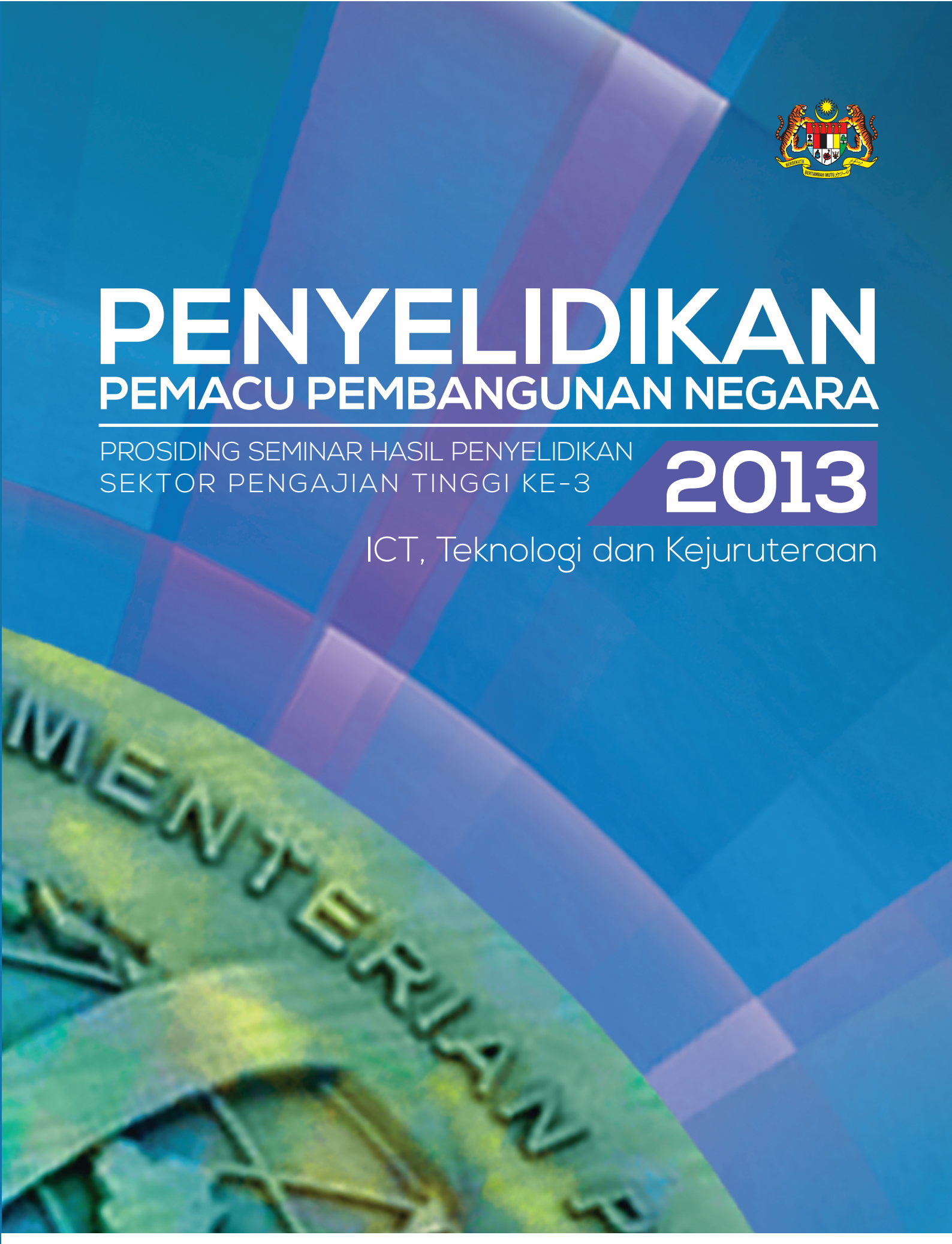
PENYELIDIKAN
PEMACU PEMBANGUNAN NEGARA

PROSIDING SEMINAR HASIL PENYELIDIKAN
SEKTOR PENGAJIAN TINGGI KE-3

2013

ICT, Teknologi dan Kejuruteraan



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PRAKATA

Prosiding ini memuatkan artikel dalam bidang (i) Teknologi Maklumat dan Komunikasi dan (ii) Teknologi dan Kejuruteraan yang dibentang oleh para penyelidik dalam Seminar Hasil Penyelidikan Sektor Pengajian Tinggi, Kementerian Pendidikan ke-3, 2013. Seminar anjuran bersama Kementerian Pendidikan dan Universiti Utara Malaysia (UUM) ini telah berlangsung pada 2 dan 3 Julai 2013 di Executive Development Centre (EDC), UUM. Penganjur seminar telah memilih tema 'Penyelidikan Mendukung Pembangunan Negara'. Tema ini amatlah tepat memandangkan dapatan penyelidikan dapat membantu pembangunan negara dalam aspek pendidikan. Himpunan artikel ini datangnya daripada penyelidikan di pelbagai institusi pengajian tinggi tempatan yang telah mendapat geran penyelidikan daripada Kementerian Pengajian Tinggi yang kini menjadi Kementerian Pendidikan. Artikel yang terpilih dan dimasukkan dalam jilid ini meliputi bidang dan subbidang berikut;

- Teknologi Maklumat dan Komunikasi
  - Perisian dan Sistem Maklumat, Pengkomputeran Lembut, Rangkaian Komputer, Keselamatan Maklumat, Multimedia, Kejuruteraan Komputer dan Sains Komputer.
- Teknologi dan Kejuruteraan
  - Mekanikal dan Pembuatan, Elektrikal dan Elektronik, Awam dan Struktur, Bahan dan Polimer, Kejuruteraan Kimia dan Proses, Tenaga dan Teknologi Hijau, Infrastruktur dan Pengangkutan, Pembinaan dan Bahan Binaan dan Aeroangkasa.

Artikel yang dimuatkan dalam prosiding ini adalah yang terpilih daripada sejumlah artikel yang diperolehi untuk pembentangan. Saringan akan dibuat oleh ahli Sidang Editor jurnal *Current Research in Malaysia (CREAM)* untuk mengenal pasti artikel yang berpotensi untuk diterbitkan dalam *CREAM*. Proses pewasitan oleh pakar dalam bidang yang berkenaan akan dilakukan ke atas semua artikel yang berpotensi untuk diterbitkan.

Kami berterima kasih kepada semua pihak yang membantu menyiapkan penerbitan prosiding ini khususnya para pegawai Bahagian Penyelidikan dan Perancangan, Kementerian Pengajian Tinggi yang kini di bawah Kementerian Pendidikan dan juga Ahli Jawatankuasa Seminar.

KU RUHANA KU MAHAMUD
MD NAJIB IBRAHIM
AHMAD KAMAL IDRIS

1

Pelaksanaan Penggunaan ICT dalam Pengajaran Bahasa Inggeris di Sekolah Rendah

Muhammad Akbar Zahidi

ABSTRAK

Pengajaran bahasa dengan melalui penggunaan ICT adalah antara kaedah pengajaran yang dianggap bersesuaian dengan keperluan pendidikan masa kini. Kajian ini adalah tentang penggunaan ICT dalam pengajaran Bahasa Inggeris di sekolah rendah. Tujuan kajian ini dilaksanakan adalah untuk melihat keberkesanan pengajaran guru dalam pelaksanaan ICT di sekolah; melihat kekerapan guru melaksanakan pengajaran menggunakan ICT dan melihat tahap penguasaan guru dalam penggunaan ICT. Maka, kajian secara tinjauan ini meneliti tahap pelaksanakan pengajaran Bahasa Inggeris melalui penggunaan ICT dengan menggunakan instrumen soal selidik. Sampel kajian terdiri daripada 310 orang guru Bahasa Inggeris di sekitar daerah Hilir Perak, Perak. Data statistik yang dikumpul dianalisis dengan menggunakan perisian SPSS 13.0 menggunakan statistik deskriptif yang berbentuk peratus, kekerapan dan min. Dapatan kajian menunjukkan penggunaan ICT dilihat sangat berkesan dan lebih menarik. Penggunaan multimedia dan pergerakan animasi dapat menarik minat murid di dalam kelas. Namun, kajian menunjukkan penggunaan ICT di kalangan guru masih di tahap yang rendah. Ini kerana, guru terpaksa membazirkan masa memasang peralatan ICT. Walau bagaimanapun, penguasaan guru dalam pengunaan ICT dilihat pada tahap yang baik. Kebanyakan guru berkemampuan menggunakan ICT hasil daripada pembelajaran di universiti dan kursus sebelum ini. Kesan pengajaran Bahasa Inggeris menggunakan ICT dilihat positif terutamanya kepada murid yang agak lemah. Dalam era dunia tanpa sempadan ini, guru dan murid perlu menggunakan setiap teknologi yang ada agar tidak ketinggalan khususnya dalam bidang Bahasa Inggeris yang banyak menggunakan ICT dalam proses pengajaran dan pembelajaran. Pengetahuan yang mendalam mengenai ICT amat penting bagi guru agar ianya dapat diaplikasikan dalam proses pengajaran dan pembelajaran Bahasa Inggeris bagi memudahkan lagi pemahaman murid. Kesimpulannya, kekangan utama yang dihadapi oleh guru dalam pelaksaan penggunaan ICT dalam pengajaran Bahasa Inggeris ialah kekangan masa untuk memasang alatan ICT di dalam kelas.

Kata Kunci: ICT, Bahasa Inggeris, Sekolah Rendah

PENGENALAN

Penggunaan ICT dalam proses pengajaran dan pembelajaran banyak memberi kesan yang baik kepada murid-murid khususnya yang di sekolah rendah. Namun begitu, terdapat juga kelemahan yang timbul kesan dan daripada penggunaan ICT dalam pengajaran dan pembelajaran. Penggunaan ICT dalam proses pengajaran dan pembelajaran dapat meningkatkan kecekapan dan keberkesanan hasil pembelajaran terutamanya dalam mata pelajaran Bahasa Inggeris. Hal ini kerana guru terpaksa membuat persiapan dan bersedia dengan lebih awal dalam menjalankan

proses pengajaran dan pembelajaran. Melalui cara ini, guru perlu mencari maklumat-maklumat berkenaan seterusnya dapat menyampaikan kepada pelajar secara berkesan. Melalui penggunaan alat ICT sebagai alat bantu mengajar, maka proses pengajaran dan pembelajaran akan lebih menarik dan dan berkesan. Contohnya ialah perisian *"power point", "flash",* video dan visual. Oleh itu, guru perlu mengaplikasikan alatan tersebut ke dalam proses pengajaran dan pembelajaran di dalam kelas. Justeru, proses pengajaran dan pembelajaran dapat di jalankan dengan lebih mudah, ringkas dan padat kerana murid akan didedahkan dengan gambaran dan persembahan menarik serta mudah untuk di fahami. Lantaran itu, pelajar tidak akan mudah merasa jemu dan bosan dalam menjalani proses pengajaran dan pembelajaran kerana tertarik dengan gaya persembahan yang ditunjukkan melalui ICT.

Di samping itu, penggunaan ICT dapat menjadikan proses pengajaran dan pembelajaran Bahasa Inggeris lebih aktif serta mewujudkan suasana pembelajaran yang menyeronokkan. Dengan adanya ICT, proses pengajaran dan pembelajaran dapat dipelbagaikan dan bukan hanya tertumpu kepada teknik pengkuliahan sahaja bahkan dapat mempertingkatkan kualiti pengajaran guru. Melalui penggunaan alat ICT, guru dapat menerangkan kepada pelajar dengan lebih terperinci serta mendalam mengenai sesuatu mata pelajaran. Contohnya penggunaan internet sebagai alat untuk mendapatkan maklumat-maklumat terkini mengenai dunia pendidikan. Kemahiran menggunakan internet membolehkan guru dan pelajar mendapatkan maklumat dan pengetahuan yang terkini dengan lebih cepat serta efisen tanpa perlu menunggu masa yang lama seterusnya dapat di gunakan dalam aktiviti pembelajaran. Oleh itu, kualiti pengajaran dan pembelajaran akan lebih berkesan kerana maklumat-maklumat dapat terus di akses ke dalam sistem.

Penggunaan ICT dalam proses pengajaran dan pembelajaran Bahasa Inggeris amat penting kerana ia dapat meningkatkan kemahiran guru dan murid. Melalui penggunaan ICT dalam proses pengajaran dan pembelajaran pelajar akan didedahkan dengan pelbagai alatan dan bahan mengenai ICT seperti komputer, LCD, CD, *"pendrive" , "hardware", "software",* internet dan sebagainya. Semua benda yang berkenaan dengan ICT mempunyai pelbagai fungsi dan kegunaannya yang tersendiri dalam menjalani proses pengajaran dan pembelajaran di sekolah. Hal ini kerana melalui penggunaan ICT dalam pengajaran dan pembelajaran, guru dan murid akan lebih menguasai teknologi-teknologi terkini yang dapat membantu dalam memahami mata pelajaran Bahasa Inggeris yang dipelajari serta menyimpan, memproses dan merekod setiap maklumat yang diperolehi. Kemahiran dalam menggunakan ICT ini mampu memberi nilai tambah kepada guru agar dapat menggunakannya untuk menyampaikan ilmu kepada murid agar ianya mudah untuk difahami. Di samping itu, guru juga dapat menambahkan pengetahuan mengenai sistem ICT melalui pengalaman yang diperolehi semasa menjalankan proses pengajaran tersebut. Ini kerana semasa proses pengajaran dan pembelajaran guru dan murid akan saling berinteraksi tentang apa yang dipelajari. Justeru, guru dan murid akan berusaha lagi menambahkan pengetahuan mengenai teknologi ICT ini.

Penyataan Masalah

Pengajaran Bahasa Inggeris tidak terkecuali daripada pengaruh ICT. Walaupun pelajaran Bahasa Inggeris hanya melibatkan penguasaan kemahiran bahasa yang kelihatannya agak mudah untuk dikuasai, namun masih terdapat beberapa isu yang dianggap boleh mengganggu keberkesanan pengajaran. Menurut Agashe (2005), 73.2% masalah tersebut termasuklah penguasaan kemahiran asas Bahasa Inggeris seperti lisan, membaca dan menulis. Pada tahap yang lebih tinggi, masih

terdapat pelajar yang tidak dapat memahami teks yang dibaca dengan sempurna. Di samping itu, pada tahap sekolah rendah, penguasaan menulis juga masih lagi perlu diberi perhatian untuk memastikan objektif pengajaran Bahasa Inggeris tercapai. Oleh hal yang demikian, penggunaan ICT dalam pengajaran Bahasa Inggeris dilihat sebagai satu usaha yang sesuai untuk memberikan impak terhadap permasalahan yang dihadapi (Bhushan, 1993). Sebagai alat bantu pengajaran, 68.4% penggunaan ICT dilihat sebagai usaha yang mampu mengubah persepsi pelajar terhadap pembelajaran Bahasa Inggeris (Cates, 2008). Menurut Cunninghan (2011), guru Bahasa Inggeris perlu mempunyai keterampilan dan pengetahuan dalam mengendalikan pengajaran bahasa melalui ICT. Walaupun terdapat kesukaran dalam melaksanakannya, guru perlu bersedia dengan kemahiran dan pengetahuan selaras dengan keperluan pendidikan kini yang memerlukan pengajaran lebih berpusatkan pelajar (Darnton, Geoffrey & Giacoletto, 2002). Oleh itu, kajian ini cuba mengkaji pemahaman guru Bahasa Inggeris terhadap konsep pengajaran bahasa melalui ICT dan tahap penguasaan guru dalam pelaksanaan ICT di bilik darjah.

Objektif Kajian

1. Melihat keberkesanan pengajaran guru dalam pelaksanaan ICT di sekolah.
2. Melihat kekerapan guru melaksanakan pengajaran menggunakan ICT.
3. Melihat tahap penguasaan guru dalam penggunaan ICT.

Persoalan Kajian

1. Sejauh manakah keberkesanan pengajaran guru dalam pelaksanaan ICT di sekolah?
2. Sejauh manakah kekerapan guru melaksanakan pengajaran menggunakan ICT?
3. Sejauh manakah tahap penguasaan guru dalam penggunaan ICT?

Kepentingan Kajian

Dengan adanya kajian ini, diharap ia akan dapat membantu pihak sekolah dalam merancang program Bahasa Inggeris dengan menggunakan ICT secara meluas supaya ia dapat dilaksanakan dengan lancar dan berkesan. Sehubungan itu, hasil kajian ini juga dapat memberikan maklumat untuk kajian-kajian yang akan datang berkaitan dengan kekangan penggunaan ICT dalam pelaksanaan pengajaran Bahasa Inggeris di sekolah rendah. Maka, hasilan kajian ini akan memberikan serba sedikit panduan kepada guru-guru untuk menangani kekangan penggunaan ICT yang menjadi antara faktor penghalang dalam pelaksanaan pengajaran Bahasa Inggeris. Selanjutnya, kajian ini adalah sebagai makluman kepada ibu bapa mengenai kepentingan penggunaan ICT ini terhadap murid-murid yang bakal menghadapi peperiksaan UPSR. Seribu harapan juga diberikan kepada guru-guru mata pelajaran lain supaya dapat menerima kepentingan pelaksanaan ICT di sekolah untuk pengajaran yang lebih berkesan. Ringkasnya, kajian ini diharapkan akan memberikan pandangan yang lebih positif terhadap pelaksanaan pengajaran Bahasa Inggeris dengan menggunakan ICT ke tahap yang maksimum untuk menghasilkan murid yang seimbang dan cemerlang di masa akan datang.

Batasan Kajian

Kajian ini hanya tertumpu kepada pelaksanaan penggunaan ICT dalam pengajaran Bahasa Inggeris di sekolah rendah.

Batasan Lokasi Kajian

Kajian ini dilakukan di sekolah rendah yang melibatkan sebuah daerah di negeri Perak Darul Ridzuan. Daerah tersebut dipilih kerana sekolah-sekolah rendah di negeri tersebut telah mencapai keseluruhan aspek kecemerlangan dalam bidang pendidikan (Jabatan Pelajaran Perak, 2012). Selain itu, sekolah-sekolah rendah di daerah tersebut merangkumi semua jenis kategori sekolah yang disenaraikan di bawah Kementerian Pelajaran Malaysia iaitu Sekolah Kebangsaan, Sekolah Jenis Kebangsaan Cina, Sekolah Jenis Kebangsaan Tamil, Sekolah Premium, Sekolah Wawasan, Sekolah Agama Islam, Sekolah Mubaligh, Sekolah Pendidikan Khas, Sekolah Amanah dan Sekolah Murid Asli (Jabatan Pelajaran Perak, 2012).

Batasan Populasi dan Sampel Kajian

Seramai 310 orang guru Bahasa Inggeris Tahap 1 daripada 155 buah sekolah rendah dijadikan responden untuk kajian ini. Memandangkan hanya sebuah daerah sahaja yang terlibat dalam kajian ini, maka dapatan yang diperoleh terbatas kepada maklumat yang didapati daripada responden kajian.

Tinjauan Literatur

Dalam kajian yang dilakukan oleh Dewal (1994), tentang penggunaan ICT di kalangan guru Bahasa Inggeris, didapati tahap penggunaan perisian pendidikan dan cakera padat dalam pengajaran dan pembelajaran berada pada tahap yang sederhana. Masalah kekurangan kemudahan ICT masih berlaku pada kajian ini. Seterusnya, kajian yang dilakukan dalam pengajaran Bahasa Inggeris oleh Driscoll (2010) menyatakan, 44% (22) daripada guru tidak pernah mendapatkan bimbingan daripada guru-guru yang bertauliah, 56% (28) tidak pernah mendapatkan bimbingan daripada juruteknik komputer dalam rangka perancangan pengajaran menggunakan ICT. Selain itu, seramai 80% guru menyatakan tidak pernah mendapat kursus bimbingan. Dalam pembinaan alat bantu pengajaran (ABP) pula, 76% guru tidak pernah menyediakan ABP sendiri melalui penggunaan ICT, manakala 54% guru tidak suka menggunakan ICT dalam pengajaran Bahasa Inggeris. Dubey (2004) juga mendapati, guru sangat kurang menggunakan alat pandang dengar seperti komputer (72%) dan television (54%) alat video (52%) radio (50%) dan menggunakan kaset (46%). Sebaliknya mereka kerap menggunakan buku teks (82%) dan mereka sangat kerap menggunakan papan hitam. Umumnya, penggunaan alat audio dan pandang dengar adalah sangat rendah.

Seterusnya, Fillingim (2009) pula meninjau persepsi guru Bahasa Inggeris terhadap tahap penggunaan ICT dalam pengajaran dan pembelajaran. Fokus kajian tertumpu kepada pengetahuan dan pemahaman guru-guru Bahasa Inggeris dalam aspek-aspek pengajaran dan pembelajaran berbantukan computer. Responden terdiri daripada 120 orang guru dari 14 buah sekolah di sebuah daerah Thailand. Analisis kajian mendapati bahawa pengetahuan dan pemahaman guru Bahasa Inggeris mengenai aspek-aspek pengajaran dan pembelajaran berbantukan computer adalah pada aras yang rendah dan perlu kepada cadangan dan langkah untuk mengatasi masalah tersebut.

Selain itu, Gautam (2006) dalam kajian penggunaan ICT dalam pengajaran Bahasa Inggeris di sekolah menengah menyatakan, hanya separuh dari sekolah yang dikaji mempunyai kemudahan peralatan komputer untuk tujuan pengajaran dan pembelajaran. Berikutan itu, ia mempengaruhi

dapatan kajian terhadap penggunaan ICT di kalangan guru. Hasil dapatan kajian mendapati, guru-guru kurang berminat menggunakan komputer dalam proses pengajaran dan pembelajaran, terutama guru-guru perempuan. Selain itu, pengetahuan guru terhadap computer juga amat kurang.

Manakala, Smith dan Cambell (2002) menyatakan, kebanyakan guru mempunyai kepakaran yang rendah dalam kebanyakan perisian computer. Sebagai kesimpulan, dari hasil kajian yang dilakukan oleh penyelidik, disimpulkan bahawa penggunaan ICT dalam pengajaran Bahasa Inggeris masih pada tahap yang rendah disebabkan kekurangan pakar dalam bidang ICT; kekurangan ketersediaan Alat Bantu Mengajar (ABM); dan kekurangan kursus yang dianjurkan oleh pihak Kementerian Pelajaran Malaysia (KPM).

Setelah membandingkan kajian-kajian dalam dan luar negara mengenai penggunaan ICT di kalangan guru Bahasa Inggeris, didapati perbezaan masih jauh mengenai perkembangan penggunaan ICT di dalam bilik darjah. Di Malaysia khususnya, guru mengalami masalah untuk memasang peralatan ICT terutanmanya guru perempuan. Ini akan menyebabkan kelewatan pengajaran dan pembelajaran berlaku. Seterusnya, kerosakan projektor LCD akan menyebabkan penggunaan ICT tidak dapat dijalankan. Tambahan pula, peruntukan yang disalurkan ke sekolah untuk peralatan ICT amat berkurangan sekali.

Selain itu, Park (2010) menjelaskan, integrasi ICT dalam pengajaran dan pembelajaran memberikan peluang kepada guru untuk memperkenalkan pembelajaran secara kontekstual kepada murid-murid. Pembelajaran ini memfokuskan pembelajaran dalam konteks aktiviti masalah sebenar dan meletakkan murid sebagai penyelesai masalah. Melalui penggunaan ICT, murid dapat menguasai pelbagai kemahiran manipulatif seperti kemahiran pemprosesan perkataan, pangkalan data dan pembentangan dengan menggunakan alat-alat teknologi. Kemahiran dan penguasaan dalam teknologi akan melahirkan murid yang lebih bersedia dan yakin sebelum memasuki alam yang lebih mencabar. Sebagi rumusan, kepentingan ICT dalam proses pengajaran dan pembelajaran tidak dapat dinafikan lagi. Pengintegrasian ICT dalam pengajaran dan pembelajaran merupakan sarana yang tepat bagi guru dalam menyampaikan ilmu pembelajaran Bahasa Inggeris di dalam bilik darajah.

METODOLOGI

Reka Bentuk Kajian

Reka bentuk kajian ini merupakan kajian deskriptif yang dilaksanakan melalui kaedah penyelidikan tinjauan *"survey method research"* yang menggunakan instrumen soal selidik. Kaedah soal selidik digunakan kerana banyak sampel boleh dipilih berbanding kaedah yang lain. Secara rasionalnya, penggunaan soal selidik mempunyai kebaikan kerana memberikan hasil respon yang kita kehendaki, mudah serta menjimatkan masa, tenaga dan merangkumi prospek yang lebih luas. Menurut Conlin (2009) reka bentuk kajian adalah kaedah bagi memperoleh maklumat yang diperlukan supaya objektif sesuatu kajian tercapai. Reka bentuk kajian deskriptif dijalankan bertujuan memberi penerangan yang sistematik mengenai fakta-fakta dan ciri-ciri sesuatu populasi atau bidang yang diminati secara tepat (Cunningham, 2011). Dalam konteks kajian, maklumat-maklumat tinjauan adalah hasil daripada soal selidik yang diperoleh. Pengumpulan dan penganalisisan data kajian secara tinjauan dilaksanakan secara kuantitatif. Menurut Danikhel

(2008), kaedah kuantitatif direka bentuk bagi mendapatkan data yang bersifat secara angka atau *"numerikal"*. Data-data yang diperoleh telah diterjemahkan pula kepada bentuk penganalisisan secara sistematik. Drexel (2009) juga menyatakan, penyelidikan secara kuantitatif amat menitik beratkan statistik dan merupakan alat utama yang sama penting dengan teori dan rangka bentuk konsep sesuatu penyelidikan itu.

Persampelan

Sampel ialah sekumpulan kecil yang dipilih dan diambil bagi mewakili populasi yang besar (Edfelt, 2009). Pemilihan sampel soal selidik kajian ini adalah secara pensampelan rawak mudah. Ini bertujuan untuk mengelakkan *"bias"* agar setiap individu mempunyai peluang yang sama untuk mewakili populasi tanpa sebarang sekatan (Edward, 2009). Untuk menentukan saiz sampel, penyelidik telah mengambil kira pandangan beberapa penyelidik yang menggunakan kaedah tinjauan. Oleh itu, penyelidik memilih guru-guru Bahasa Inggeris yang mengajar Tahap Satu sebagai sampel kajian yang bersifat kuantitatif.

Pensampelan Instrumen Soal Selidik

Populasi kajian soal selidik terdiri daripada guru-guru yang mengajar mata pelajaran Bahasa Inggeris di negeri Daerah Hilir Perak dianggarkan lebih kurang 1600 orang (PPD Hilir Perak, 2012). Menurut jadual penentuan sampel Krejcie dan Mogan (1970), kadar populasi 1600 adalah bersamaan 310 sampel. Kedua-dua penulis tersebut menentukan saiz sampel dengan mengambil kira aras kesignifikanan pada $p > .05$ (aras kebolehpercayaan = 9.95%). Sehubungan itu, sisihan pensampelan ialah kadar saiz sampel kepada saiz populasi. Jika nilai sisihan pensampelan kurang daripada 0.05 (atau 5%), maka penyelarasan perlu dilakukan untuk saiz sampel yang kecil (Gautam, 2006). Ia dilakukan untuk memberi bilangan sampel yang cukup terutamanya untuk analisis yang kompleks di mana lebih daripada 2 kategori dalam suatu pemboleh ubah bebas yang diukur.

Instrumen

Instrumen yang dipilih untuk membuat kajian ini ialah soal selidik. Soal selidik yang telah dibina adalah berdasarkan teoritikal kajian, objektif kajian dan kajian-kajian lampau (Hulicl, 2007). Penyelidik telah merujuk kepada 7 orang panel penilai (pakar) untuk menyemak kesahan kandungan reka bentuk soal selidik dan indeks kebolehpercayaan instrumen kajian ini. Instrumen yang baik adalah instrumen yang dibina sendiri oleh penyelidik bagi maksud pengumpulan data dalam sesuatu kajian (McNeely. 2008). Oleh itu, seseorang penyelidik tidak begitu digalakkan untuk mengambil sebarang contoh, bentuk dan jenis soal selidik yang sedia ada atau yang dikeluarkan oleh agensi atau bank item daripada sumber-sumber maklumat pengujian bagi penyelidikan pendidikan atau daripada pihak pengeluar dan pembekal soal selidik seperti *"Mental Measurements Year books (MMY)"* (McPherson, 2011). Menurut Oates (2008), alasan seseorang penyelidik tidak begitu digalakkan membeli soal selidik yang dikatakan standard dalam sesuatu kajian kerana terbukti sebagai *"well-business of selling test"* dengan meletakkan nilai pekali kebolehpercayaan melebihi 0.90 sebagai iklan, sedangkan ia sebenarnya tidak boleh dipertanggungjawabkan. Alasan lain ialah kerana penyataan-penyataan berkenaan hanya sesuai

digunakan pada masa tersebut sahaja dan menjadi tidak relevan pada masa kajian kini yang sedang dijalankan di samping kriteria-kriteria dalam pembinaan pernyataan *"total test"* dan indikator pernyataan (sub item) yang berbeza (Parlikar, 1999).

Instrumen Soal Selidik

Penyelidik menggunakan skala Likert 5 poin untuk mengukur pandangan ataupun perasaan seseorang guru terhadap kekangan-kekangan yang dihadapi. Penggunaan skala Likert dalam pengukuran pandangan adalah lebih mudah dan cepat berbanding teknik terawal iaitu teknik skala Thurstone (Shitole, 1996). Dengan adanya perisian komputer SPSS 13.0, maka proses analisis data menjadi lebih afektif dan efisen.

Kesahan Kandungan Soal Selidik

Penyelidik menggunakan kesahan kandungan ke atas instrumen soal selidik kajian ini. Kesahan kandungan merupakan penilaian yang sistematik ke atas isi kandungan ujian untuk menentukan sama ada domain tingkah laku yang diukur mewakili keseluruhan kandungan sesuatu domain (Clem, 2010). Secara amnya, kesahan kandungan dapat ditingkatkan dengan menilai pernyataan ujian berdasarkan spesifikasi ujian oleh panel pakar rujuk yang akan menyemak, menilai dan memberi komen sama ada pernyataan-pernyataan tersebut meliputi semua kandungan yang ingin diuji (Cohen, 2008). Tambahan menurut Bonk (2009) pula, kesahan kandungan yang tinggi dikatakan wujud apabila kesemua sasaran kandungan ujian diliputi secara sama rata. Untuk memastikan setiap pernyataan yang terkandung dalam soal selidik dapat mengukur domain atau gagasan yang ingin dikaji dalam kajian ini, jasa baik 7 orang panel pakar dalam bidang kurikulum Bahasa Inggeris yang terdiri daripada pensyarah universiti tempatan, institut pendidikan guru dan guru cemerlang Pendidikan Jasmani telah dirujuk. Tujuan tindakan tersebut adalah untuk menyemak semua kesesuaian pernyataan-pernyataan yang akan digunakan dalam kajian ini (Agashe, 2005).

Tindakan ini adalah sehaluan dengan saranan Clem (2010) bahawa, kesahan kandungan bergantung pada pengadilan semata-mata dan setiap pernyataan dalam soal selidik perlu dikaji serta dipertimbangkan dengan saksama oleh pengadil-pengadil lain yang cekap dan mahir dalam sesuatu disiplin ilmu. Selain itu, tindakan ini dimantapkan oleh Conlin et al. (2009) bahawa, kesahan kandungan sesuatu alat pengukuran merujuk kepada sejauh mana alat itu dapat mengumpul data yang merangkumi kandungan sesuatu bidang ingin dikaji. Tambahan beliau lagi, sesuatu alat pengukuran dianggap mempunyai kesahan yang tinggi sekiranya alat tersebut dapat mengukur semua isi domain atau bidang dengan berkesan. Berdasarkan senarai skor yang diberikan oleh sekumpulan panel pakar setelah menilai setiap domain pernyataan dalam instrumen kajian ini, nilai skor *"Cronbach Alpha"* ialah 0.790 hingga 0.819. Secara kesimpulannya, nilai skor "*Cronbach Alpha*" dalam kesahan kandungan yang dilakukan ialah 0.806. Untuk menentukan penyataan-penyataan yang harus dikekalkan atau disingkirkan, data ujian boleh dianalisis dengan analisis item. Penyataan yang mempunyai nilai alpha kurang daripada 0.65 akan disingkirkan daripada alat kajian kerana mempunyai kebolehpercayaan yang rendah (Davies, 2002).

Kebolehpercayaan Instrumen Kajian

Menurut Edward (2009), pekali kebolehpercayaan yang bernilai sekurang-kurangnya 0.60 adalah sebagai asas untuk menentukan nilai kebolehpercayaan soal selidik yang digunakan dalam kajian. Penyelidik menggunakan *"Pearson Coefficient Correlation"* untuk mengukur kebolehpercayaan pernyataan-pernyataan soal selidik dengan menggunakan skala Likert.

Uji-uji Semula *"test-retest"* Instrumen Soal Selidik

Dalam kajian rintis ini, penyelidik menggunakan cara *"test-retest"* untuk menguji darjah kebolehpercayaan pernyataan. Ia menjelaskan, darjah skor yang sentiasa konsisten setiap masa apabila ia diuji. Instrumen yang sama dinilai secara 2 kali kepada kumpulan sampel yang sama, pada masa yang berlainan (Hulick, 2007). Dua set data yang diperoleh akan dianalisis menerusi analisis korelasi untuk melihat kekuatan perhubungannya. Sekiranya pekali kolerasi *"coefficients reliability"* menghampiri nilai 1, maka kedua-dua set data tersebut mempunyai perkaitan atau perhubungan yang kuat iaitu instrumen mempunyai nilai kebolehpercayaan yang tinggi (Edfelt, 2009).

Penyelidik telah menganalisis kajian rintis ujian 2 yang dibuat 3 minggu seterusnya setelah beberapa pernyataan dalam kajian rintis satu perlu diubah suai dan diperbaiki. Beberapa pernyataan dalam soal selidik yang menyebabkan nilai pekali kebolehpercayaan rendah telah diperbaiki daripada instrumen kajian. Pernyataan-pernyataan tersebut adalah tidak sesuai kerana ia mengelirukan serta memberi persepsi yang berbeza di antara responden yang berlainan. Beberapa struktur ayat pernyataan telah diubahsuai supaya ia dapat difahami oleh sampel dan memberi makna yang lebih tepat. Soal selidik yang telah siap diubah dan disusun akan diuji dalam kajian rintis ujian 2. Seramai 30 responden yang sama telah digunakan untuk menguji ketekalan dalaman terhadap penyataan-penyataan yang dibina. Hasil daripada kajian rintis ujian 2 ini, didapati nilai pekali kebolehpercayaan ialah 0.839. Ini menunjukkan, soal selidik tersebut mempunyai nilai kebolehpercayaan yang tinggi dan sesuai digunakan untuk kajian.

Analisis Data

Penganalisisan data bertujuan untuk menjadikan data yang dikutip agar lebih bermakna. Davies (2002) memperincikan kenyataan tersebut dengan mengatakan semua data kuantitatif bukan hanya perlu direkodkan, malah data tersebut mesti dilaporkan sama ada dalam bentuk perkataan, angka ataupun graf agar maklumat dapat difahami dengan lebih mudah dan jelas. Penganalisisan data bagi kajian ini berdasarkan jenis data yang dikutip secara data kuantitatif. Selanjutnya, penganalisisan data menggunakan kaedah statistik deskriptif.

DAPATAN KAJIAN

Keberkesanan Pengajaran Guru

Jadual 1 menunjukkan analisis statistik deskriptif mengenai keberkesanan pengajaran guru dalam penggunaan ICT di dalam bilik darjah.

Jadual 1: Keberkesanan Pengajaran Guru

Bil	Penyataan	STS N (%)	TS N (%)	AS N (%)	S N (%)	SS N (%)	Min	Sisihan Piawai
1	Pengajaran menjadi lebih menarik	9 (2.9)	24 (7.7)	49 (15.8)	77 (24.8)	151 (48.7)	4.09	1.101
2	Menambah minat murid dalam pengajaran	17 (5.5)	29 (9.4)	65 (21.0)	74 (23.9)	135 (40.3)	3.84	1.208
3	Murid lebih menumpukan perhatian	10 (3.2)	22 (7.1)	58 (18.7)	102 (32.9)	118 (38.1)	3.95	1.069
4	Murid lebih faham	5 (1.6)	17 (5.5)	38 (12.3)	105 (33.9)	145 (46.8)	4.19	.961
5	Pengajaran dapat dilaksanakan dengan mudah	13 (4.2)	29 (9.4)	43 (13.9)	69 (22.3)	156 (50.3)	4.05	1.181
	Min Keseluruhan							

STS÷Sangat Tidak Setuju, TS÷Tidak Setuju, AG÷Agak Setuju, S÷Setuju, SS÷Sangat Setuju

Berdasarkan Jadual 1, kesemua penyataan menunjukkan tahap min yang tinggi. Bagi penyataan 'pengajaran menjadi lebih menarik' (*M*=4.09, *SP*=1.101); 'menambah minat murid dalam pengajaran' (*M*=3.84, *SP*=1.208); 'murid lebih menunpukan perhatian' (*M*=3.95, *SP*=1.069); 'murid lebih faham' (*M*=4.19, *SP*=0.961) dan 'pengajaran dapat dilaksanakan dengan mudah' (*M*=4.05, *SP*=1.181).

Jadual 1: Kekerapan Pelaksanaan ICT

Bil	Penyataan	STS N (%)	TS N (%)	AS N (%)	S N (%)	SS N (%)	Min	Sisihan Piawai
1	Sekurang-kurangnya sekali sebulan	6 (1.9)	20 (6.5)	40 (12.9)	69 (22.3)	175 (56.5)	4.25	1.033
2	Sekurang-kurangnya sekali seminggu	7 (2.3)	16 (5.2)	34 (11.0)	67 (21.6)	186 (60.0)	**4.32**	1.010
3	Sekurang-kurangnya sekali setahun	9 (2.9)	22 (7.1)	38 (12.3)	72 (23.2)	169 (54.5)	4.19	1.086
4	Tidak perlu	8 (2.6)	20 (6.5)	54 (17.4)	79 (25.5)	149 (48.1)	4.10	1.067
5	Setiap hari	7 (2.3)	22 (7.1)	49 (15.8)	67 (21.6)	165 (53.2)	4.16	1.074
	Min Keseluruhan							

STS÷Sangat Tidak Setuju, TS÷Tidak Setuju, AG÷Agak Setuju, S÷Setuju, SS÷Sangat Setuju

Berdasarkan Jadual 2, kesemua penyataan menunjukkan tahap min yang tinggi. Bagi penyataan 'sekurang-kurangnya sekali sebulan' (*M*=4.25, *SP*=1.033); 'sekurang-kurangnya sekali

seminggu' (*M*=4.32, *SP*=1.010); 'sekurang-kurangnya sekali setahun' (*M*=4.19, *SP*=1.086); 'tidak perlu' (*M*=4.10, *SP*=1.067) dan 'setiap hari' (*M*=4.16, *SP*=1.074).

Jadual 3: Tahap penguasaan guru dalam penggunaan ICT

Bil	Penyataan	STS N (%)	TS N (%)	AS N (%)	S N (%)	SS N (%)	Min	Sisihan Piawai
1	Saya boleh memasang LCD Projector sendiri	5 (1.6)	11 (3.5)	65 (21.0)	88 (28.4)	141 (45.5)	4.13	.969
2	Saya boleh membina ABM dengan menggunakan ICT	3 (1.0)	16 (5.2)	52 (16.8)	86 (27.7)	153 (49.4)	4.19	.959
3	Saya boleh menggunakan Power Point Presentation	9 (2.9)	25 (8.1)	62 (20.0)	74 (23.9)	140 (45.2)	4.00	1.113
4	Saya boleh membina multimedia sebagai ABM	12 (3.9)	33 (10.6)	63 (20.3)	48 (15.5)	154 (49.7)	3.96	1.216
5	Saya boleh menggunakan ICT sebagai lembaran kerja	10 (3.2)	29 (9.4)	47 (15.2)	66 (21.6)	158 (51.0)	4.07	1.151
	Min Keseluruhan							

STS÷Sangat Tidak Setuju, TS÷Tidak Setuju, AG÷Agak Setuju, S÷Setuju, SS÷Sangat Setuju

Berdasarkan Jadual 3, kesemua penyataan menunjukkan tahap min yang tinggi. Bagi penyataan 'saya boleh memasang LCD Projector sendiri' (*M*=4.13, *SP*=0.969); 'saya boleh membina ABM dengan menggunakan ICT' (*M*=4.19, *SP*=0.959); 'saya boleh menggunakan Power Point Presentation' (*M*=4.00, *SP*=1.113); 'saya boleh membina multimedia sebagai ABM' (*M*=3.96, *SP*=1.216) dan 'saya boleh menggunakan ICT sebagai lembaran kerja' (*M*=4.07, *SP*=1.151).

Rumusan Dapatan Dan Perbincangan

Sebagai pendidik, guru Bahasa Inggeris perlu memiliki kemahiran dan pengetahuan serta memahami prosedur mengajar dengan cara yang berkesan. Oleh itu, keberkesanan pengajaran guru perlu diukur untuk melihat penguasaan murid dalam mata pelajaran Bahasa Inggeris. Dapatan analisis juga menunjukkan, 73.5% bersetuju bahawa pengajaran guru akan menjadi lebih menarik dengan menggunakan ICT. Dapatan ini disokong oleh Isler-Hamilies (2009) kerana murid lebih tertarik dengn grafik yang bergerak dan berwarna warni. Selain itu, sejumlah 64.2% bersetuju bahawa penggunaan ICT akan menambah minat murid terhadap pembelajaran Bahasa Inggeris. Dapatan ini pula disokong oleh Inamdar (2001) bahawa, penggunaan ICT dapat merangsang minat murid untuk belajar dengan lebih tekun. Manakala, sebanyak 71% bersetuju bahawa murid lebih menumpukan perhatian sekiranya guru menggunakan ICT di dalam bilik darjah. Dapatan ini disokong oleh Menon (2004) di mana, pembelajaran terhadap sesuatu yang bergerak dan berbunyi adalah lebih diminati oleh murid berbanding pembelajaran yang statik. Seterusnya, 80.7% bersetuju bahawa, murid lebih faham terhadap pembelajaran yang menggunakan ICT berbanding ABM yang lain. Dapatan ini disokong oleh Mullick (1999) bahawa, daya ingatan murid menjadi lebih kuat dengan menggunakan ICT. Justeru, sejumlah

72.6% bersetuju bahawa, pengajaran melalui ICT dapat dilaksanakan dengan mudah. Dapatan ini disokong oleh Park (2010) bahawa, penggunaan ICT dapat meringankan beban guru sewaktu proses pengajaran dan pembelajaran berlaku.

Selain itu, bagi melihat kekerapan penggunaan ICT, sejumlah 78.8% bersetuju menggunakan ICT sekurang-kurangnya sekali sebulan. Dapatan ini disokong oleh Oates (2008) bahawa penggunaan ICT tidak perlu dilaksanakan secara kerap kerana ia boleh menimbulkan rasa bosan terhadap sesuatu topik. Manakala, 81% bersetuju menggunakan ICT sekurang-kurangnya sekali seminggu. Dapatan ini disokong oleh Parlikar (1999) bahawa, penggunaan sekali seminggu dapat merangsang minat murid terhadap mata pelajaran yang ajar. Seterusnya, 75.7% bersetuju menggunakan ICT sekurang-kurangnya sekali setahun. Dapatan ini tidak disokong oleh Perkins et al. (2007), bahawa, ketiadaan penggunaan ICT boleh membosankan murid di dalam kelas. Sehubungan itu, 73.6% bersetuju tidak perlu menggunakan ICT di bilik darjah. Dapatan ini bertentangan dengan Prabhakar (2005) bahawa, guru perlu menggunakan ICT sebagai ABM di sekolah. Justeru, 74.8% bersetuju penggunaan ICT sepatutnya dilakukan setiap hari. Dapatan ini disokong oleh Shitole (1996) bahawa, sekiranya guru mampu untuk membina ABM sendiri dengan menggunakan ICT, maka jadikanlah ICT sebagai alat ABM setiap hari.

Seterusnya, mengenai tahap pengusaan guru dalam penggunaan ICT, 73.9% bersetuju guru boleh memasang LCD Projektor sendiri. Pandangan tersebut disokong oleh McPherson (2011) bahawa, guru perlu mahir dalam ICT. Manakala, 77.1% bersetuju guru boleh membina ABM dengan menggunakan ICT. Pandangan tersebut disokong oleh Ankney (2007) bahawa, guru lebih mudah faham ABM yang dihasilkan oleh guru itu sendiri. Selanjutnya, 69.1% bersetuju bahawa guru boleh menggunakan "*Power Point Presentation*" sebagai ABM. Pandangan tersebut disokong oleh Benson (2009) bahawa, "*Power Point Presentation*" merupakan ABM yang mudah difahami dan teratur. Manakala, seramai 65.2% responden bersetuju bahawa guru boleh membina multimedia sebagai ABM. Pandangan tersebut disokong oleh Bonk (2009) bahawa, multimedia sebagai ABM adalah lebih menarik kerana mempunyai pergerakan dan suara yang jelas. Sehubungan itu, seramai 72.3% responden bersetuju menggunakan ICT sebagai lembaran kerja. Pandangan tersebut disokong oleh Cosmos (2008) bahawa, lembaran kerja yang menggunakan ICT adalah lebih jelas dan tersusun.

Cadangan Kajian Lanjutan

Memandangkan kajian ini menghadapi beberapa batasan seperti mana yang dibincangkan, maka beberapa cadangan telah diajukan seperti mana berikut iaitu:

a) Proses penilaian terhadap instrumen soal selidik yang dibina berdasarkan teori, objektif dan kajian-kajian lepas telah berjaya dilakukan ke atas kesemua sampel kajian di sebuah daerah. Justeru, dicadangkan untuk kajian-kajian lanjutan agar menggunakan sampel yang lebih luas ke atas guru-guru Bahasa Inggeris di sebuah negeri.
b) Dalam proses membina reka bentuk kajian, dicadangkan kajian lanjutan mempelbagaikan penggunaan kaedah kajian seperti eksperimen, temu bual dan pemerhatian agar dapatan yang diperoleh lebih mantap kerana wujudnya data-data sokongan yang lain. Kajian lanjutan yang menggunakan pelbagai kaedah lain akan memperkukuhkan hasil dapatan sebelumnya.

KESIMPULAN

Perkembangan dalam bidang teknologi maklumat dan komunikasi (ICT) serta penggunaan komputer dalam bidang pendidikan menjadikan ilmu lebih mudah diakses, disebar dan disimpan. Manakala kecanggihan serta kemampuannya menyampaikan sesuatu maklumat secara cepat, tepat dan menarik dalam bentuk multimedia menjadikannya sebagai satu daya tarikan ke arah mewujudkan satu senario belajar yang lebih menyeronokkan. Dalam hal ini profesion perguruan pada alaf baru ini haruslah mampu menguasai dan menggabungkan kemahiran-kemahiran yang berkaitan untuk melahirkan satu bentuk pendidikan yang lebih bermakna dan bestari. Walau bagaimanapun dalam bidang pendidikan sekarang, kecanggihan teknologi melalui persembahan multimedianya bukanlah hanya faktor yang boleh menjadikan proses pembelajaran itu berkesan. Keberkesanan dan kebestarian sesuatu pengajaran itu masih banyak bergantung pada faktor manusia iaitu guru yang membuat perancangan. Teknologi hanyalah sebagai faktor pemangkin ke arah mempercepatkan proses keberkesanannya, manakala kemahiran dari aspek pedagogi serta psikologi adalah diperlukan. Oleh itu guru harus mampu mengintegrasikan ketiga-tiga aspek pedagogi, psikologi dan teknologi dalam proses penyampaian ilmu. Usaha ini harus dilakukan secara berterusan ke arah melahirkan seorang pelajar yang berfikirkan kritis dan kreatif, seimbang dari segi intelek, rohani dan jasmani serta dapat hidup dalam keadaan yang harmonis yang berpegang teguh pada agama dan kepercayaan pada Tuhan seperti mana yang terdapat dalam Falfasah Pendidikan Negara.

Namun begitu, terdapat kajian yang membuktikan bahawa kesediaan guru menggunakan teknologi maklumat di dalam pengajaran bahasa ke atas guru Bahasa Inggeris menunjukkan majoritinya guru-guru masih takut untuk menggunakan komputer dalam pengajarannya. Aplikasi komputer yang kurang dalam pengajaran bahasa di sekolah-sekolah adalah disebabkan guru-guru tidak mempunyai kemahiran dan latihan yang secukupnya. Dengan ini, kerajaan perlu melipat gandakan usaha menangani masalah tersebut terutama di kalangan guru-guru. Sebenarnya, kemajuan pesat dalam bidang teknologi maklumat telah membawa banyak perubahan terhadap kaedah pengajaran Bahasa Inggeris. Daripada kaedah konvensional di dalam bilik darjah, pengajaran bahasa kini telah berkembang kepada kaedah pengajaran yang baru, iaitu pengajaran bahasa di alam siber. Dengan kaedah baru ini, para pendidik bahasa dapat berkomunikasi dan mengajar melalui komputer yang dihubungkan dengan modem dan perisian komunikasi. Pengajaran yang menggunakan kaedah baru ini dapat membantu mengembangkan penggunaan Bahasa Inggeris di kalangan murid. Memandang bahawa penggunaan teknologi maklumat ini masih baharu dalam sistem pendidikan di Malaysia, guru Bahasa Inggeris perlu mempunyai literasi teknologi dan memahami keperluan komunikasi secara global. Hal ini dapat membantu guru Bahasa Inggeris menerapkan kaedah ini dengan berkesan.

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Muhammad Akbar Zahidi
SK Seksyen 9, Shah Alam
akbarzahidi@yahoo.com.my

2

Harmonic Content under different Excitation on 3-Phase 1000kVA Transformer Wound Core

Emi Zurima Ismail & Dina Maizana

ABSTRACT

This paper is about to investigate the harmonic flux under different excitation which are under excited, operation and saturation mode on 3 phase 1000kVA transformer wound core build with Amorphous ribbon. The methodology that used to investigate is arrays of search coil at no load test. This investigation involves the harmonic content of induced voltage at every point. Zigzag style is used for arrangement of transformer core. The magnetic flux for under excited mode is 0.3T, operation mode is 1T and saturation mode is 1.5T. For 0.3T, harmonic at A30 is lower than A10 about 4.44% and lower than A60 about 11%. For 1T, harmonic at A30 is lower than A10 about 5.07% and lower than A60 about 6.91%. For 1.5T, harmonic at A30 is lower than A10 about 3.08% and lower than A60 about 2.67%. When refer to one location only,A30, where is in the middle of butt joint shows harmonic in operation mode 1T is higher than under excited mode 0.3T and saturation mode 1.5T about 3.38% and 7.89% respectively. So, harmonic is low at middle of butt joint at saturation mode, 1.5T. The harmonic value is affected by differentiation of location at amorphous ribbon.

Keywords: Harmonic, Harmonic Factor, Transformer core, amorphous ribbon

ABSTRAK

Tujuan kertas kerja ini adalah untuk menyiasat fluks harmonik di bawah ujaan yang berbeza yang berada di bawah teruja, operasi dan mod tepu pada teras pengubah 3 fasa 1000kV. Kaedah yang digunakan dalam penyiasatan ini adalah tatasusunan gegelung carian pada ujian tanpa beban. Penyiasatan ini meliputi kandungan harmonic voltan aruhan pada tiap-tiap titik. Gaya siku-sika digunakan untuk susunan teras pengubah. Fluks magnet di bawah mod teruja adalah 0.3T, mod operasi adalah 1T dan mod tepu adalah 1.5T. Untuk 0.3T, harmonik di A30 adalah lebih rendah daripada A10 sebanyak 4.44% dan lebih rendah daripada A60 sebanyak 11%. Untuk 1T, harmonik di A30 adalah lebih rendah daripada A10 sebanyak 5.07% dan lebih rendah daripada A60 sebanyak 6.91%. Untuk 1.5T, harmonik di A30 adalah lebih rendah daripada A10 sebanyak 3.08% dan lebih rendah daripada A60 sebanyak 2.67%. Apabila merujuk kepada satu lokasi sahaja, A30, di mana di tengah-tengah sambungan potongan menunjukkan harmonik dalam operasi mod 1T adalah lebih tinggi daripada mod teruja 0.3T dan mod tepu 1.5T kira-kira 3.38% dan 7.89%. Jadi, harmonik yang rendah di tengah-tengah sambungan potongan dan pada mod tepu, 1.5T untuk reben Amorfus. Nilai harmonik dipengaruhi oleh perbezaan lokasi di reben Amorfus.

Kata kunci- Harmonik, Faktor Harmonik, Teras pengubah, reben Amorfus.

INTRODUCTION

There are many types of transformer core design in industry. For wound-core transformer design, they have one-phase core type, one-phase shell type and three-phase shell type [1]. Amorphous ribbon also used as transformer core. They have been selected because of their several characteristic that can give an advantage to the performance of transformer itself. However, there is a problem need to be considered in order to make sure the core material will give a better performance to transformer. The problems is harmonic occurred in those two core material [2]. Harmonic will disturb voltage and current output at transformer and will bring to some losses to the power system [2]. Many researchers have trying to find what cause of harmonic [1]. Harmonic will give an effect to distribution transformer no-load loss [1]. Amorphous steel is also known as metallic glass or glassy metal. Most of the metals are crystalline in their solid state [3]. These will bring them to have a highly ordered arrangement of atoms. It is a non-crystalline and has a glass structure. Unlike common glasses which are typically insulator, amorphous metal has a good electrical conductivity [3]. The viscosity prevents the atoms moving enough to form an ordered pattern. The energy loss (hysteresis loss) is small when flux of magnetic induction passes the iron core [4]. Eddy current loss reduced because thickness is approximately 0.33mm which is 1/10 comparing with silicon steel [4]. It contains iron-boron-silicon (Fe_{78} B_{13} Si_9). Saturation mode for amorphous ribbon is at 1.56T.

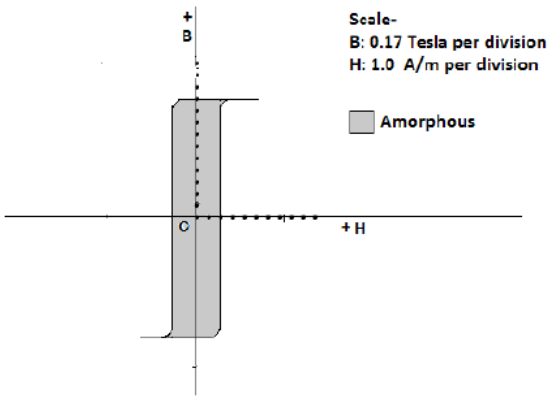


Figure 1: B-H curve for amorphous ribbon [1]

As refer in Fig. 1, it shows that Amorphous ribbon has low core loss, low magnetising current, low zero sequence current, less noise, higher inrush current and longer life. However amorphous ribbon will give third harmonic effect to transformer because input voltage is increase and flux density also increases. Harmonic in simple word means a wave whose frequency is an integer multiple of the fundamental frequency [5]. When the higher frequency value added to fundamental frequency waveform, it will become distortion to the fundamental [5]. As refer to Fig. 2, fundamental frequency is 60Hz, when the frequency is added by multiple of three, the order of harmonic will become third order. Same if frequency added by multiple of five, the order of harmonic will become fifth order. It clearly stated that sum of first harmonic until fifth harmonic will become a complex waveform. Positive sequence of harmonic will have same phase rotation as fundamental voltage frequency, 50 Hz. First, seventh, thirteenth, nineteenth order of harmonic are the example of positive sequence harmonics [5].

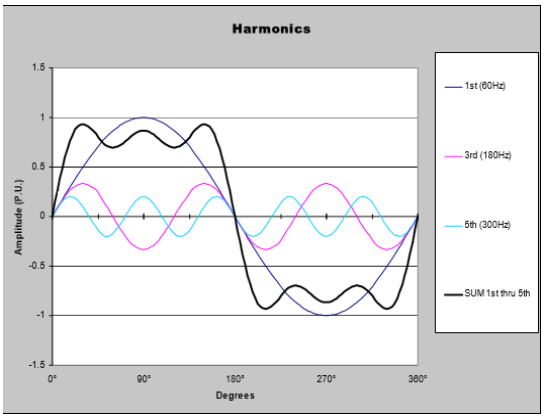
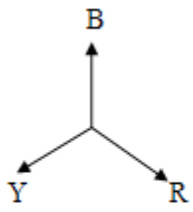


Figure 2: Harmonic definition

It will consist of three phasors:

- Each equal in magnitude
- Separated from each other by 120°
- Having same phase sequence as 50Hz current
- Negative sequence of harmonic will have phase rotation opposite as fundamental voltage frequency, 50 Hz.

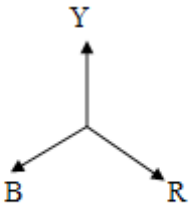


Positive sequence R-Y-B

Figure 3: Positive sequence

Fifth, eleventh, seventeenth orders of harmonic are the example of negative sequence harmonics [5]. It will consist of three phasors:

- Each equal in magnitude
- Separated from each other by 120°
- Phase sequence opposite as 50Hz



Negative sequence R-B-Y

Figure 4: Negative sequence

Zero sequence of harmonic does not rotate relative to the fundamental voltage frequency. It is also known as triplen harmonics [5]. It will consist of three phasors:

- Each equal in magnitude
- Zero phase displacement from each other
- All three phasor are concurrent in direction and it will produce amplitude triples of any other phasor when they combine on neutral. Example of zero sequence is third, nineth, and fifteenth. It normally generated by phase – neutral of non-linear load [5].

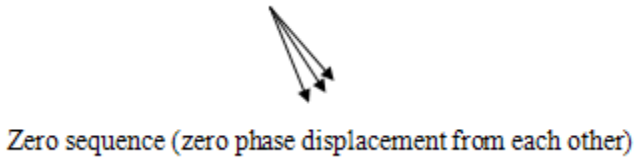


Figure 5: Zero sequence

Graphical method is used to calculate harmonic content from the graph. The equation for harmonic content shows by the Fourier series such as:

$$= 0 + 1\sin + 1 + 2\sin + 2 + \ldots + \sin + \quad (1)$$

From previous research shows the measurement of longitudinal flux at step-lap joint by using two turns search coil [6]. The arrangement of search coil will give the distribution of flux density at step-lap joint were determined accurately [6]. For harmonic investigation, previous researcher conducted the experiment by constantly maintained the SCR trigger angle and load resistance value but varying the input voltage [7]. It shows that power factor is affected by harmonic content of the system. The power factor decreases as total harmonic distortion increases [7].

The objective of this paper is to measure the harmonic content on amorphous ribbon of transformer core at different excitation and different location at butt joint.

EXPERIMENTAL SETUP

The design of core lamination for this experiment is zigzag style. Lap length between each lamination is about 0.5cm. The gap length is adjusted as small as possible. Fig. 6 shows the diagram of the design. Width for Amorphous ribbon is 0.14m and its thickness is 45μm. Fig. 7 shows the plan view and side view of the transformer. The transformer used is 3 phase wound core type as shown in Fig. 8. About 38 layer of amorphous ribbon has been used including inner and outer part of transformer.

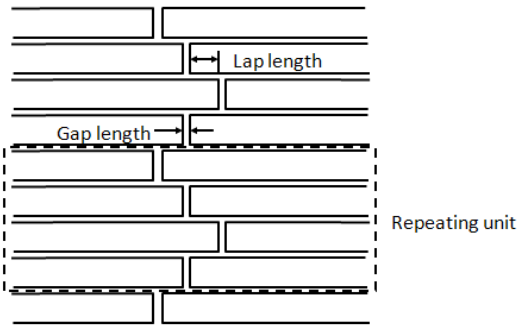


Figure 6: Diagram of the core lamination

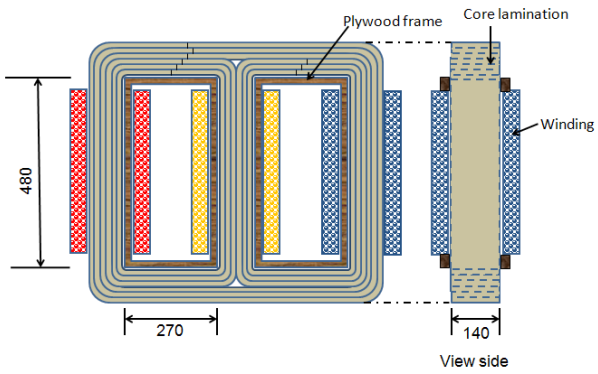


Figure 7: Plan view and side view of the transformer

The equation used to get input voltage and this voltage need to supply at windings coil with Tesla of flux density.

$$V = 4.44 \times B \times N \times f \times A \quad (2)$$

Where
V = Voltage
4.44 = Constant
B = Tesla
N = Number of winding turn = 254 turns
f = Frequency = 50 Hz

Oscciloscope is important in order to get the waveform for harmonic current. Then, we should know all this value below:
A = Cross sectional on the surface of yoke = n x t x w [m]
N = number of layer of yoke lamination = 38 layers
t = thickness of yoke lamination [m] = 45μm for Amorphous ribbon
w = width of yoke lamination [m] = 0.14m

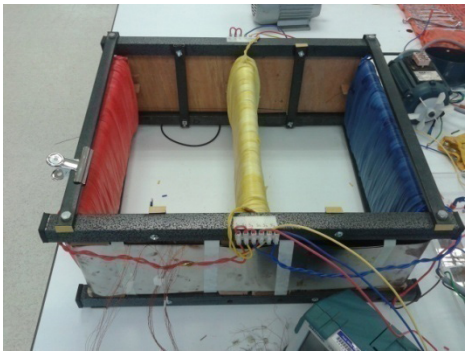


Figure 8: Transformer using Amorphous ribbon as its core

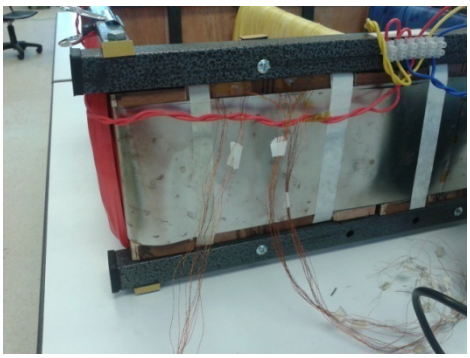


Figure 9: Search coil used to measure harmonic

As refer to Fig. 9, arrays of search coil are used to measure harmonic at different location for amorphous ribbon.

RESULT & DISCUSSION

Input voltage is getting by calculating using Eq. 2. Three different excitation need to be considered are excited, operation and saturation mode. Table 1 shows input voltage used to start the measurement of harmonic.

Table 1: Calculation result for input voltage

Condition	Flux (T)	Input Voltage (V)
Excited	0.3	4.05
Operation	1	13.5
Saturation	1.5	20.25

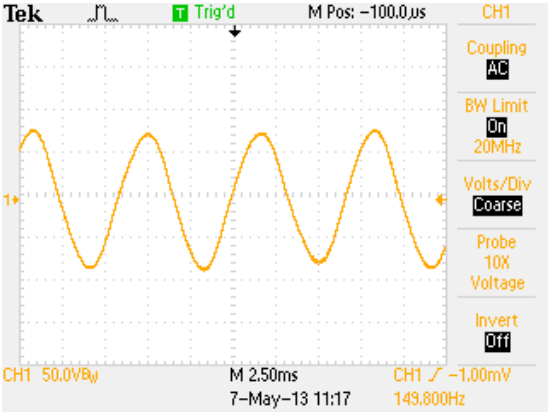


Figure 10: Induced voltage for 0.3T at A10

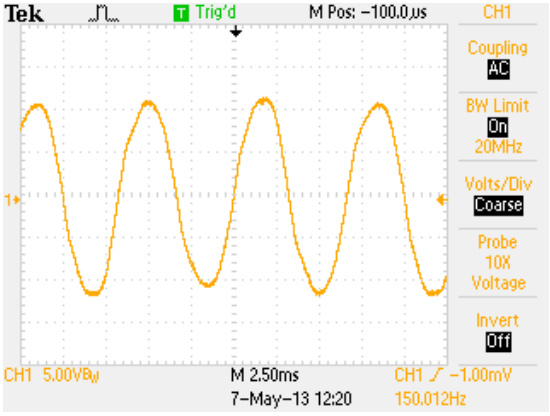


Figure 11: Induced voltage for 0.3T at A30

For under excited mode, the induced voltage of amorphous ribbon core material at flux density of 0.3T will give by location A10 can refer to Fig. 10. Next, induced voltage for location A30 and A60 can be seen in Fig. 11 and Fig. 12 respectively. Magnetic flux of 0.3T will give an input voltage 4.05V. For operation mode, the induced voltage of amorphous ribbon core material at flux density of 1T given by location A10 can refer to Fig. 13. Next, induced voltage for location A30 and A60 can be seen in Fig. 14 and Fig. 15 respectively. Magnetic flux 1T will give an input voltage 13.5V.

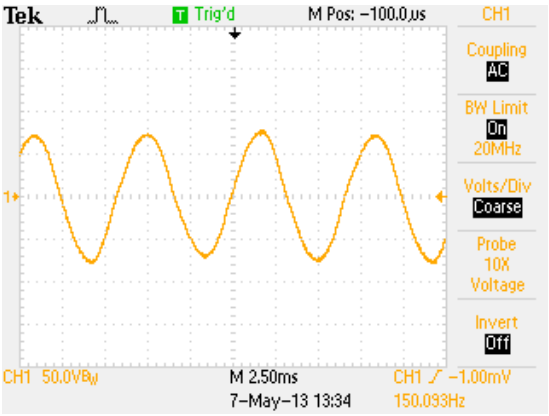


Figure12: Induced voltage for 0.3T at A60

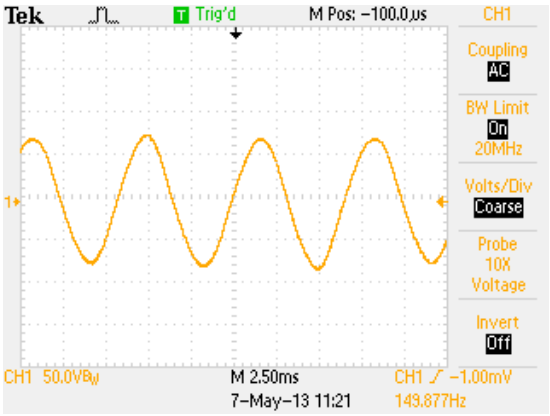


Figure 13: Induced voltage for 1T at A10

For saturation mode, the induced voltage of amorphous ribbon core material at flux density of 1.5T given by location A10 can refer to Fig. 16. Next, induced voltage for location A30 and A60 can be seen in Fig. 17 and Fig. 18 respectively. Magnetic flux of 1.5T will give an input voltage 20.25V.

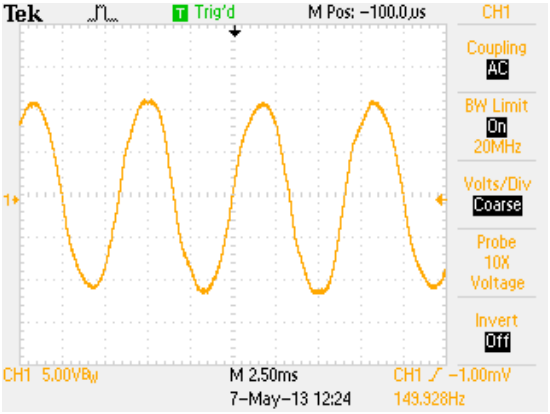


Figure 14: Induced voltage for 1T at A30

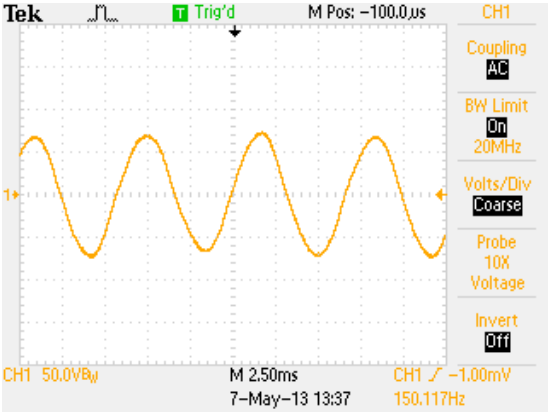


Figure 15: Induced voltage for 1T at A60

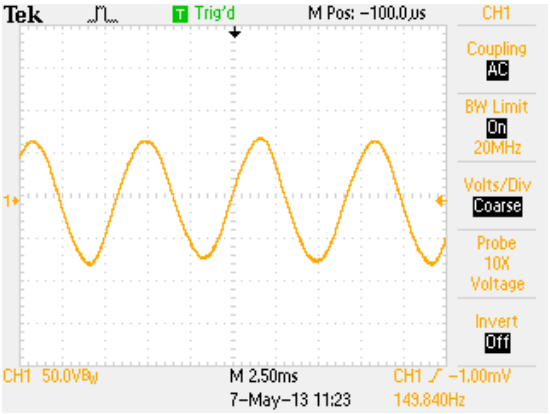


Figure 16: Induced voltage for 1.5T at A10

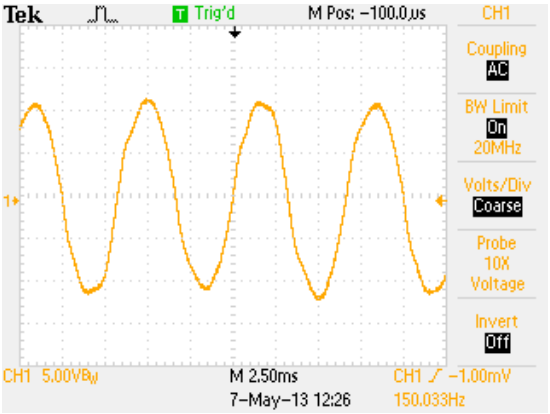


Figure 17: Induced voltage for 1.5T at A30

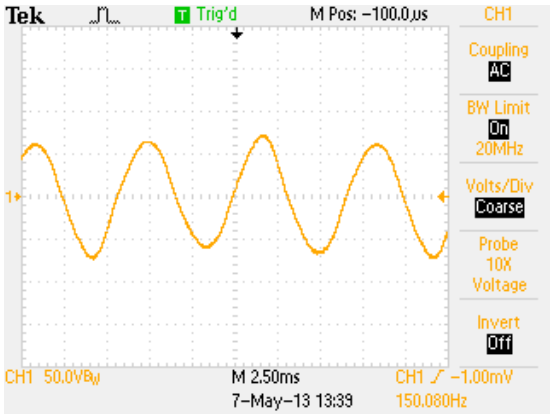


Figure 18: Induced voltage for 1.5T at A60

Location A10 and A60 show on the corner side of butt joint of Amorphous ribbon while for location A30 shows on the middle of butt joint of Amorphous ribbon. Butt joint is connection between two cut of lamination.

Harmonic content can be getting by using graphical method. This can be done using Eq. 1. The 3rd order of harmonic is the highest harmonic value and easily to be seen in the waveform. As the odd order of harmonic increases, the value is getting smaller and hardly to be seen when refer to the waveform. That is the reason why 3rd order of harmonic is considerable in this investigation.

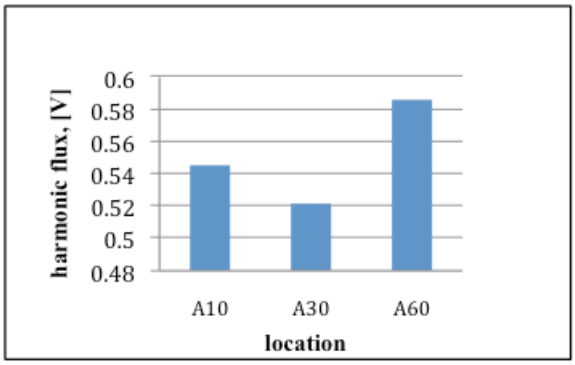


Figure 19: Harmonic flux for flux density of 0.3T,50 Hz

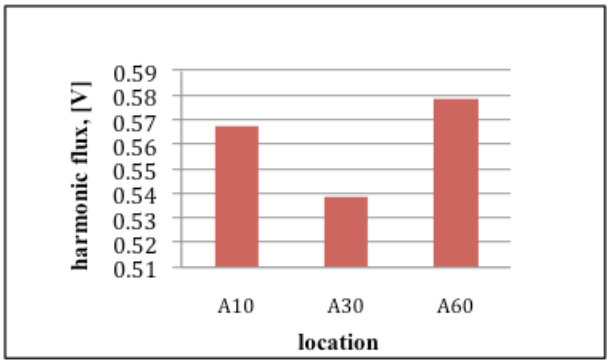


Figure 20: Harmonic flux for flux density of 1T, 50 Hz

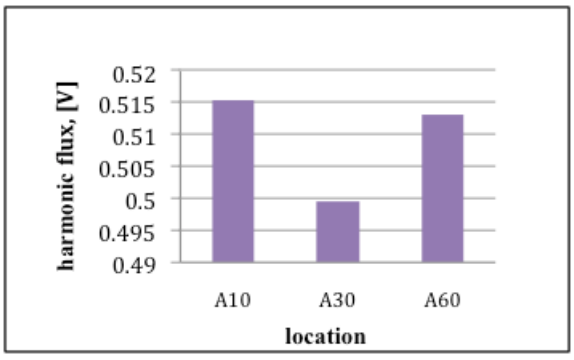


Figure 21: Harmonic flux for flux density of 1.5T, 50 Hz

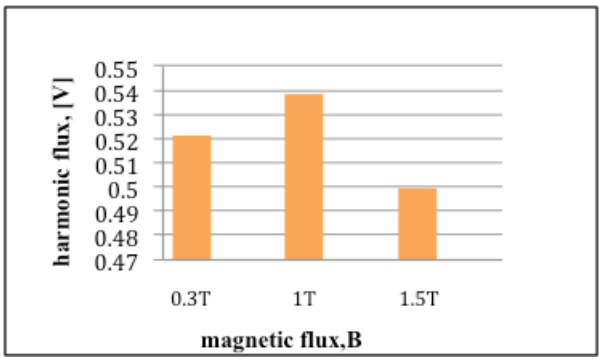


Figure 22: Harmonic flux at location A30

From Fig. 19 shows that the under excited mode 0.3T, harmonic flux of location A30 is lower than location A10 about 4.44% and lower than location A60 about 11%. Next, from Fig. 20 shows for operation mode 1T, harmonic flux of location A30 is lower than location A10 about 5.07% and lowers than location A60 about 6.91%. Then, from Fig. 21 shows for saturation mode 1.5T, harmonic flux of location A30 is lower than A10 about 3.08% and lower than location A60 about 2.67%. From Fig. 22 focusing harmonic only at one location A30, where is in the middle of butt joint. It shows harmonic in operation mode 1T is higher than under excited mode 0.3T and saturation mode 1.5T about 3.38% and 7.89% respectively. During saturation mode, harmonic factor is the lowest at A30 as this stage the material amorphous ribbon start to saturate itself.

On the other hand, if using harmonic fundamental of flux value, location A30 will show the highest harmonic flux value compared to location A10 and A60. These can be shown using

MATLAB software. Fig. 23 shows the result that middle of butt joint is higher than at the corner side of butt joint during under operation mode same goes to under excited mode and saturation mode. It means the fundamental harmonic at A30 is always higher than at A10 and A60 regardless under any excitation. The value of fundamental harmonic of flux is getting smaller as it distance from the middle of the butt joint. It happens differently if 3rd order of harmonic applied. The harmonic flux will always be lower at location A30 for all excitation. This is because harmonic flux value will become higher as it approach corner side of butt joint when transformer energized.

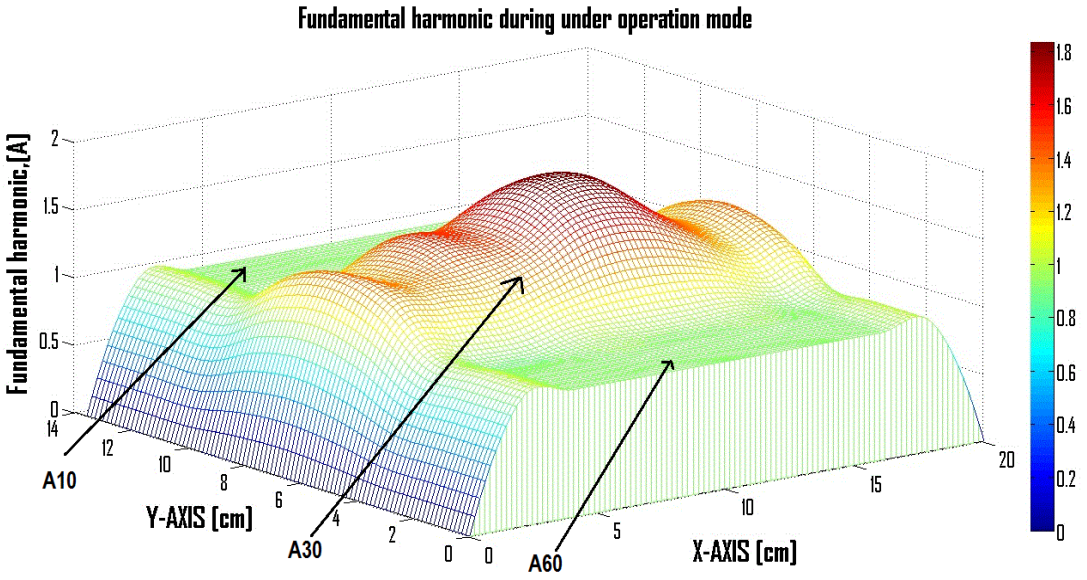


Figure 23: Fundamental harmonic during under operation mode

CONCLUSION

From this investigation, it is clearly mention that fundamental harmonic is high at the middle of butt joint on Amorphous ribbon in excited mode, operation mode and saturation mode. However, the 3rd order of harmonic is low at the middle of butt joint for all excitation. So, the harmonic is actually affected by differentiation of location at amorphous ribbon.

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Emi Zurima Bt Ismail
School of Electrical System Engineering
Universiti Malaysia Perlis, Malaysia
E-mail: ezurima@gmail.com, dina@unimap.edu.my
Contact Number: +6017-4823648

Dina Maizana
School of Electrical System Engineering
Universiti Malaysia Perlis, Malaysia
E-mail: dina@unimap.edu.my
Contact Number: +6016-4363589

3

Pembinaan Indikator Kelestarian Pendidikan Teknikal dan Vokasional Sekolah Menengah Harian Melalui Kajian Delphi

Asnul Dahar Minghat & Ruhizan M.Yasin

ABSTRAK

Tujuan kertas kerja ini adalah untuk membincangkan pandangan panel pakar tentang indikator kelestarian pendidikan teknikal dan vokasional (PTV)di sekolah menengah harian. Strategi kelestarian pembangunan untuk pendidikan teknikal dan vokasional serta latihan oleh *International centre for technical and vocational education and training* (UNEVOC) dijadikan asas dalam pembentukan indikator kelestarian pendidikan teknikal dan vokasional. Seramai 12 orang panel pakar dalam bidang Pendidikan Teknikal dan Vokasional pelbagai peringkat dalam negara ini telah terlibat sebagai peserta kajian Delphi. Sebanyak 20 indikator kelestarian pendidikan teknikal dan vokasional telah dikenal pasti melalui kajian Delphi. Implikasi kajian yang telah dijalankan menyentuh tentang perlunya indikator kelestarian pendidikan teknikal dan vokasional yang telah dikenal pasti diberi perhatian oleh pihak atau pusat tanggungjawab PTV agar ianya mapan khususnya memenuhi konsep kelestarian dan dalam mencapai visi dan misi negara.

Kata kunci : Pendidikan teknikal dan vokasional, Kajian Delphi,Kelestarian, Kelestarian pembangunan

PENDAHULUAN

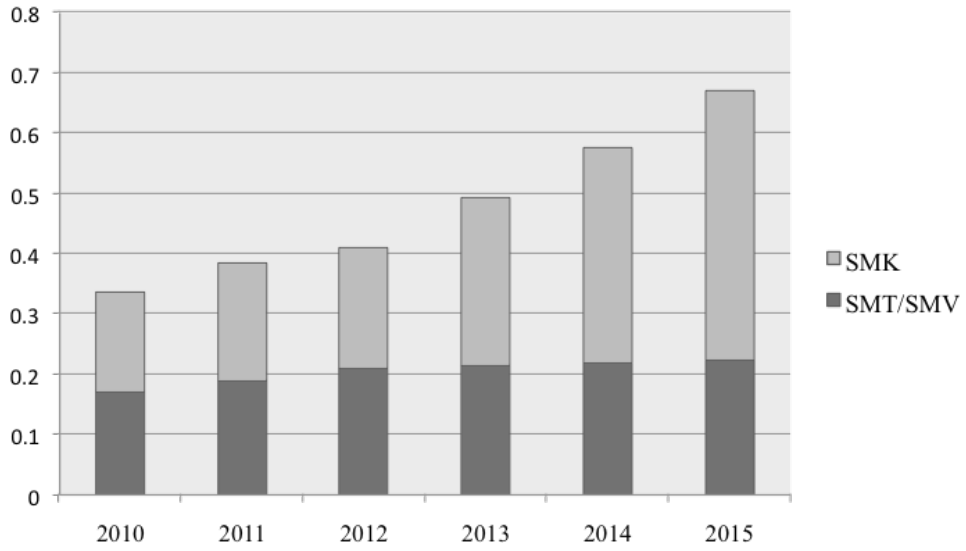
Sektor pendidikan khususnya dalam pendidikan teknikal dan vokasional (PTV) di Malaysia mengalami transformasi dalam pelbagai dimensi.Semua ini dilaksanakan demi melahirkan modal insan bertaraf global yang mempunyai daya saing tinggi dan berkemahiran (Mohamad Rizal 2011).Pada 10 Jun 2010, perdana menteri, Datuk Seri Mohd Najib Tun Abdul Razak telah membentangkan usul Rancangan Malaysia Ke-10 (RMK-10 2011-2015) di Dewan Rakyat. RMK-10 yang bertemakan 'Rancangan Kemakmuran Ekonomi dan Keadilan Sosial' menggariskan program pembangunan lima tahun negara sehingga 2015 serta memperuntukkan RM230 bilion bagi perbelanjaan pembangunan dalam tempoh berkenaan. Satu daripada lima teras strategik utama bagi mencapai objektif serta sasaran yang ditetapkan dalam RMK-10 ialah membangun dan mengekalkan modal insan bertaraf dunia. Sewaktu menghuraikan teras strategik berkenaan, perdana menteri turut menyentuh mengenai rancangan bagi meningkatkan kualiti pelajar serta mengarusperdanakan pendidikan teknikal dan vokasional.

Di negara maju seperti Jerman, pendidikan teknikal dan vokasional serta latihan vokasional menjadi antara pilihan utama pelajar kerana ia menyediakan prospek kerjaya yang baik (Ivan 2007). Sebaliknya di Malaysia, ia masih dilihat sebagai pilihan terakhir kerana persepsi prospek kerjaya yang terhad.Andaian negatif ini haruslah disangkal kerana pendidikan teknikal dan latihan vokasional sebenarnya menyediakan landasan alternatif yang baik bagi pelajar merealisasikan potensi mereka (Mohd Fuad 2010). Sebelum ini, pendidikan vokasional dilihat tertinggal di belakang dalam arus perdana pendidikan negara, sekali gus memberi gambaran kedudukannya yang seolah-olah dipinggirkan. Oleh yang demikian agenda besar negara untuk mengarusperdanakan pendidikan teknikal dan vokasional adalah satu langkah yang tepat.

Namun sejak pembentangan usul RMK-10, kerajaan melalui Kementerian Pelajaran Malaysia (KPM) mengorak langkah drastik dan bersifat pragmatik ke arah mengangkat martabat pendidikan vokasional sebagai 'pemain utama' dalam sektor pendidikan negara pada masa depan. Negara sangat memerlukan modal insan yang memiliki ilmu pengetahuan dan kemahiran tinggi dalam bidang vokasional kerana keperluan pasaran yang semakin mendesak khususnya dalam sektor industri (Ahmad Tajudin 2010).

Sebelum pada itu, Gagasan Satu Malaysia (1Malaysia) telah dikemukakan oleh Perdana Menteri Malaysia ketika mula menerajui kepimpinan Malaysia pada bulan April 2009.Ia sebagai satu panduan untuk rakyat bergerak ke arah pembentukan satu negara bangsa yang utuh. Untuk memantapkan lagi penerimaan rakyat pada konsep ini, kepimpinan negara telah mengemukakan janji pada rakyat melalui apa yang dikenali sebagai Bidang Keberhasilan Utama (*National Key Result Areas-NKRA*). Menurut beliau terdapat enam NKRA yang telah dibentuk bagi mencapai cita-cita dan slogan Satu Malaysia iaitu: (i) Mengurangkan kadar jenayah, (ii) Memerangi rasuah, (iii) Memperluaskan akses kepada pendidikan berkualiti dan berkemampuan, (iv) Meningkatkan taraf hidup rakyat yang berpendapatan rendah, (v) Memperkasa prasarana luar bandar dan pedalaman, dan (vi) Menambah baik pengangkutan awam dalam jangka masa sederhana (Utusan Malaysia 2009).

Justeru, KPM telah menetapkan *National Key Performance Indicator* (NKPI) khusus berasaskan NKRA yang ketiga iaitu memperluaskan akses kepada pendidikan berkualiti dan berkemampuan. Untuk memperlihatkan peranan pendidikan ke arah keberhasilannya, KPM telah menggariskan enam NKPI dan salah satu daripada itu ialah NKPI yang kelima iaitu meningkatkan penyertaan pelajar sebanyak 100% dalam aliran vokasional dan kemahiran. Jelas di sini bahawa pendidikan teknikal dan vokasional akan memainkan peranan lebih penting dalam agenda negara. Sementara itu, *Minister Key Performance Indicators* (MKPIs), KPM mensasarkan penyertaan pelajar sebanyak 100% dalam aliran vokasional dan kemahiran pada akhir tahun 2015. . Mulai tahun 2010 hingga 2015 terdapat peningkatan pelajar yang mengambil MPV. Rajah 1.1 menunjukkan *key performance indicator* bagi KPM untuk meningkatkan penyertaan pelajar 100% dalam aliran vokasional dan kemahiran bagi lima tahun bermula pada tahun 2010 hingga 2015.



Rajah 1.1 *Key Performance Indicator (KPI)* Kementerian Pelajaran Malaysia untuk Pengambilan Pelajar di Sek.Men. Teknik/Vokasional dan Sek. Men. Keb. Bagi Aliran Vokasional dan Mata Pelajaran Vokasional dari tahun 2010-2015. Sumber : Bahagian Pendidikan Teknik & Vokasional, KPM 2009

Pada awal tahun ini semasa pelancaran Transformasi Pendidikan Vokasional, pada 6 Januari 2012 di Institut Jerman-Malaysia, Bangi, Selangor oleh Timbalan Perdana Menteri iaitu Tan Sri Dato' Muhyiddin Mohd Yassin menegaskan, "Dalam Model Baru Ekonomi yang diumumkan oleh Perdana Menteri, Datuk Seri Mohd. Najib Tun Abdul Razak, dinyatakan bahawa kejayaan melahirkan modal insan yang berkeupayaan untuk berinovasi dan meneroka bidang baharu bagi menjanakan kekayaan negara merupakan faktor yang kritikal bagi menentukan pencapaian kemajuan dan kemakmuran masa hadapan negara Malaysia. Pertumbuhan ekonomi nasional menuntut peningkatan bilangan graduan dalam bidang vokasional dan teknikal."

Transformasi pendidikan vokasional merupakan usaha merekayasa (*reengineering*) sistem pendidikan vokasional sedia ada sehingga terbina sistem pendidikan vokasional baharu yang dapat menyumbang kepada agenda transformasi Malaysia sebagai negara berpendapatan tinggi (KPM 2011).Antara matlamat transformasi pendidikan vokasional yang telah dilancarkan oleh Timbalan Perdana Menteri ialah mewujudkan sistem pendidikan vokasional baharu digerakkan oleh sumber manusia yang responsif kepada pelbagai inisiatif kerajaan dan berkolaborasi dengan industri bagi menginovasi pengajaran dan pembelajaran yang berupaya menghasilkan tenaga kerja mahir dan usahawan.Di samping itu, melahirkan tenaga kerja mahir dan usahawan yang berdaya saing, memiliki kelayakan dan kemahiran yang diiktiraf, berwatak profesional dan diterima oleh pasaran kerja.

LATAR BELAKANG MASALAH KAJIAN

Kelestarian didefinisikan sebagai keadaan yang tidak berubah atau yang terpelihara seperti asal (Kamus Dewan 2002). Konsep kelestarian *(sustainability)* adalah merupakan sebahagian daripada wacana perbincangan peringkat antarabangsa semenjak tahun 80an lagi. Menurut Pavlova (2009), istilah kelestarian pembangunan atau pembangunan lestari *(sustainable development)* mempunyai pelbagai makna dan definisi bergantung kepada sesuatu organisasi. Begitu juga dengan Huckle (1996) yang menyatakan kelestarian pembangunan mempunyai pelbagai takrifan yang bergantung kepada idealogi, pengetahuan, nilai-nilai serta falsafah-falsafah yang dipegang.Sementara (Morris 2004; Pitt & Lubben 2009) menyatakan kelestarian pembangunan atau kelestariansecara umumnya didefinisikan seperti dalam Brundtland Commission (1987).

Konsep kelestarian pembangunan atau kelestarian telah mula didefinisikan buat kali pertamanya di dalam *Brundtland Commission Report, the World Commission on Environment andDevelopment*. Menurut Brundtland (1987: 37), kelestarian pembangunan telah dikonsepkan dalam pelbagai maksud dan satu daripadanya ialah "…*development that meets the needs of the present without compromising the ability of future generation to meet their own needs*..."

Aspirasi dan cita-cita negara adalah untuk melangkah jauh ke hadapan sebagai sebuah negara industri yang maju. Bagi mencapai hasrat ini, pembangunan sistem pendidikan bertaraf dunia yang memberi tumpuan kepada pembangunan modal insan berpengalaman, berkemahiran, progresif, bermoral serta beretika tinggi telahpun diberi penekanan oleh kerajaan. Pertumbuhan ekonomi negara yang kian pesat telah mengakibatkan permintaan tenaga pekerja yang tinggi dalam bidang teknikal dan vokasional terutamanya dalam kumpulan tenaga mahir dan separa mahir.

PTV merupakan *master-key* kepada kelestarian pembangunan (Mohamed Jallah, 2004). Kelestarian pembangunan ditegaskan agar masyarakat perlu prihatin terhadap pembangunan yang dilakukan sekarang tidak akan menjejaskan kehidupan serta kesejahteraan masyarakat pada zaman akan datang. Dalam konteks ini, pelaksanaan PTV diharapkan agar dapat melahirkan lebih ramai lagi tenaga kerja negara bagi meningkatkan lagi pertumbuhan ekonomi negara.Aspek ekonomi adalah satu elemen dalam kelestarian pembangunan atau kelestarian dan melalui PTV, negara mengharapkan dapat melahirkan lebih ramai pelajar-pelajar yang cenderung ke bidang-bidang kemahiran yang berkaitan.

Seterusnya konsep kelestarian juga agak bersamaan dengan matlamat pendidikan vokasional iaitu meningkatkan kualiti kehidupan. Sehubungan dengan itu, kajian yang dijalankan ini adalah untuk mencari atau menentukan indikator-indikator kelestarian yang total untuk mendapat tempat di hati pelajar yang seterusnya akan mengikuti dan meneroka bidang berkaitan untuk kesejahteraan kehidupan mereka dan pembangunan ekonomi negara.Usaha ini adalah untuk membantu negara meningkatkan kualiti kehidupan masyarakat negara ini dan menyahut dan membantu hasrat negara seperti yang termaktub dalam RMK-10. Begitulah juga dengan beberapa perancangan hala tuju negara yang dibentangkan dalam RMK-9 dan Gagasan Satu Malaysia sebelum RMK-10 dibentangkan pada bulan Oktober 2010 yang lalu. Oleh kerana pada masa ini masih belum ada indikator kelestarian PTV maka pengkaji menggunakan kajian atau kaedah Delphi untuk membina indikator kelestarianPTV sekolah menengah harian.

KAJIAN DELPHI

Kajian Delphi digunakan untuk menggabungkan dan memurnikan pendapat daripada satu kumpulan pakar yang *heterogen* berdasarkan maklumat yang dibekalkan secara kolektif dalam proses penghakiman (Jones 1979). Kajian Delphi pernah digunakan oleh Dunlap, Daresh dan Ganter & Hvizdak (1998) dalam proses penyediaan instrumen kajian pengetua yang melibatkan pengetua-pengetua yang masih bertugas di daerah El Paso, Texas dan juga pengetua-pengetua berkesan yang bertugas di universiti. Teknik ini lebih merupakan satu proses kumpulan yang menggunakan respon bertulis daripada membawa individu untuk berbincang bersama. Pada umumnya kajian Delphi mempunyai tiga sifat yang istemewa iaitu ketelusan, maklum balas terkawal dan analisis statistik kumpulan (Dalkey 1972 & Armstrong 1989). Menurut Linstone dan Turoff (1975) lima asas utama kajian Delphi adalah; (i) sampel dipilih secara individu dan setiap sampel tidak mengetahui jawapan sampel lain dalam kumpulan panel pakar yang dibentuk, (ii) sampel hanya mengetahui jawapan sampel lain pada pusingan kedua apabila pengkaji melakukan analisis data dan menghantar dapatan kepada setiap ahli panel, (iii) sampel tidak menerima sebarang tekanan dari mana-mana pihak mahupun sampel lain dalam menentukan jawapan soal selidik mereka, (iv) data dianalisis secara statistik, dan (v) data yang diberi oleh sampel adalah tiada pilih kasih (tidak bias) dan dengan demikian panel memainkan peranan untuk mencari penyelesaian.

Pengkaji memilih kajian atau teknik Delphi ini kerana merupakan satu teknik yang jarang digunakan secara khusus dalam pendidikan teknikal dan vokasional pada peringkat menengah pada masa ini. Dalam konteks PTV di dalam negara ini kajian Delphi pernah dijalankan oleh Mohd Nor dan Wahid (2003) yang bertajuk "Kajian Teknik Delphi bagi Pembangunan Staf terhadap e-pembelajaran". Kajian tersebut hanyalah berfokus kepada PTV di IPTA.

Oleh kerana masih kurangnya penggunaan kajian Delphi dalam PTV khususnya dalam negara ini, pengkaji mengaplikasikan kaedah ini dalam kajian ini.Linstone dan Turoff (1973) menyatakan kajian Delphi adalah satu ciri kaedah yang menstrukturkan proses komunikasi berkumpulan menjadi lebih berkesan antara kumpulan individu atau keseluruhannya semasa menyelesaikan masalah-masalah yang kompleks. Panel pakar diminta untuk mengenal pasti, menjelaskan, memurnikan dan akhirnya mencapai kesepakatan terhadap isu-isu tertentu melalui beberapa siri pusingan soal selidik (Saedah 2005).Kelebihan kaedah kajian ini ialah panel pakar tidak perlu bertemu atau bersemuka.Oleh itu, seorang pakar boleh menyatakan pandangan beliau tanpa dipengaruhi oleh pakar yang lain (Steward et al. 1999; McGill 1998; Czinkota & Ronkainen 1997; Robbins 1996).Pakar yang telah dipilih pula adalah dirahsiakan daripada pengetahuan pakar yang lain.

Pengkaji memilih menjalankan kajian Delphi setelah mengambil kira beberapa pandangan seperti pengkaji-pengkaji terdahulu yang menggunakan kaedah ini. Di samping beberapa kelebihan lain yang menyebabkan pengkaji terpanggil menggunakan kaedah kajian Delphi antaranya; (i) Kajian Delphi berupaya mendapatkan persetujuan panel pakar yang tulen kerana setiap pakar tidak mengenal malah tidak pernah bertemu antara satu sama lain, (ii) Kesepakatan atau konsensus panel pakar dapat dicapai tanpa pilih kasih, pengaruh dan tekanan mana-mana pihak, (iii) Panel pakar berupaya melahirkan pendapat mereka yang konsisten dengan bidang

kepakaran masing-masing, (iv) Kajian Delphi sesuai digunakan untuk melakukan jangkaan masa depan, dan (v) Kajian Delphi digunakan dengan efektif bagi mendapatkan banyak pendapat ke atas sesuatu isu yang kompleks.

Pemilihan peserta kajian terutamanya dalam kajian Delphi seharusnya dibuat dengan teliti kerana kesilapan dalam membuat pemilihan akan menyebabkan keputusan atau dapatan yang sebaliknya (Helmer 1968; O'Halloron et al. (1999); Lanford 1972; Martino 1972).

SAMPEL KAJIAN DELPHI

Beberapa orang pengkaji lepas telah mengemukakan beberapa pendapat dalam menentukan saiz sampel atau bilangan panel pakar melalui kajian Delphi.Steward et al. (1999) berpendapat bahawa sesuatu panel pakar yang dibentuk yang mempunyai ahli seramai 7 hingga 100 orang amat sesuai untuk memperoleh dapatan kajian yang mantap. Walau bagaimana pun Linstone dan Turoff (1975) menyanggah pendapat itu kerana ramainya panel pakar akan menyukarkan lagi dan sering menimbulkan implikasi negatif sewaktu melaksanakan kajian lapangan. Seterusnya mereka mencadangkan bilangan panel pakar yang sesuai adalah seramai 5 hingga 10 orang sahaja agar kajian yang dijalankan mencapai objektif yang ditetapkan. Sementara itu menurut Delbecq et al. (1975) dan Ludwig (1997) menegaskan bilangan panel pakar seramai 3 hingga 5 orang adalah terlalu kecil dan tidak berupaya untuk memberi maklum balas mengenai sesuatu isu yang telah dikenal pasti. Seterusnya mereka mencadangkan panel pakar haruslah terdiri dari kumpulan yang seragam, seperti pakar dari kumpulan disiplin yang sama dan perlukan penglibatan pakar antara 10 hingga 20 orang sahaja.

Sementara itu Dalkey et al. (1972) mencadangkan agar setiap kajian Delphi adalah memadai untuk melibatkan melebihi 10 orang panel pakar untuk menghasilkan dapatan kajian yang mantap. Bersesuaian dengan pandangan tersebut, pengkaji menetapkan bilangan panel pakar dalam kajian Delphi yang telah dijalankan adalah seramai 12 orang sahaja.

KRITERIA PEMILIHAN SAMPEL KAJIAN DELPHI

Kajian Delphi digunakan kerana ia direka bentuk untuk mengoptimumkan input yang akan diperoleh daripada individu-individu yang terlibat dalam kumpulan panel pakar yang dibentuk. Perkara yang paling penting diberi perhatian dalam penggunaan kajian Delphi ialah pemilihan pakar.Kamus Dewan (2007) mendefinisikan pakar sebagai orang yang ahli dalam sesuatu ilmu atau bidang.Sementara itu Dalkey (1972) pula mendefinisikan pakar sebagai orang yang berpengetahuan dalam sesuatu bidang tertentu.

Tajul Ariffin (1997) mencadangkan beberapa kriteria berikut sebagai panduan bagi memilih seseorang menjadi panel pakar.Antaranya ialah penampilan diri yang baik dan dihormati oleh golongan profesional, bilangan kertas kerja yang telah dihasil dan dibentangkan kepada umum pada peringkat kebangsaan atau antarabangsa, bahan penerbitan yang telah berada di pasaran serta jumlah kajian yang telah dilaksanakan.Berdasarkan pandangan tersebut, kajian Delphi yang bersifat persampelan bertujuan atau "*purposive sampling*" pengkaji mengambil kira kriteria tersebut dan juga kriteria-kriteria yang telah dibincangkan diawal tadi.

Berdasarkan dua definisi maksud 'pakar' di atas, pengkaji menetapkan pemilihan pakar untuk kajian yang telah dijalankan berdasarkan kepada tiga kriteria iaitu; (i) Mempunyai Ijazah Doktor Falsafah (Ph.D) dalam bidang PTV; bagi pensyarah Institut Pendidikan Guru (IPG) telah berkhidmat antara 10-15 tahun atau bagi guru telah mengajar melebihi 10 tahun, (ii) Mempunyai pengetahuan tentang kurikulum dan pelaksanaan mata pelajaran teknikal dan vokasional samada di peringkat universiti, institut pendidikan guru, sekolah, dan (iii) Golongan yang terlibat dalam secara langsung dalam pelaksanaan MPV khususnya di Kementerian Pelajaran Malaysia. Thangaratinam dan Redman (2005) menegaskan bahawa pemilihan individu sebagai panel pakar adalah bergantung kepada objektif yang dibina sebagai persoalan kajian Delphi.Apa yang penting adalah kualiti ahli panel pakar dan bukanlah kuantiti. Sementara French et al. (2002) pula menerangkan bahawa panel pakar dipilih adalah berdasarkan kerelaan dan keupayaan mereka menyatakan pendapat tentang topik yang akan dibincangkan serta mempunyai pengalaman mendalam berhubung perkara tersebut.

DAPATAN KAJIAN

Sampel kajian Delphi

Penganalisisan data mengenai kategori ini melibatkan aspek berikut iaitu jantina, gelaran jawatan dan pengalaman dalam bidang pendidikan teknikal dan vokasional pelbagai peringkat di Malaysia.

a. Peserta kajian Delphi mengikut jantina dan gelaran jawatan

Seramai 12 orang telah melibatkan diri mereka secara aktif dalam kajian Delphi.Mereka terlibat dalam temu bual yang dijalankan di institusi masing-masing untuk mendapatkan pandangan dalam mengenal pasti indikator kelestarian PTVsekolah menengah harian di Malaysia.Seramai lapan orang staf akademik dari IPTA dan IPTS iaitu enam orang lelaki dan dua orang perempuan, seorang pensyarah IPG lelaki, dua orang pegawai pelajaran dari Kementerian Pelajaran Malaysia dan seorang guru pakar perempuan telah dilantik menjadi panel pakar kajian Delphi. Proses pemilihan mereka adalah mengikut kriteria pemilihan panel pakar kajian Delphi yang telah ditetapkan pada awal perancangan kajian ini. Jadual 1.1 menunjukkan perincian penganalisisan kategori peserta kajian Delphi berdasarkan jantina.

Jadual 1.1 Gelaran dan jawatan panel pakar kajian Delphi

Gelaran Jawatan	Lelaki	Perempuan	Jumlah
	(orang)	(orang)	(orang)
Staf Akademik IPTA	6	1	7
Staf Akademik IPTS	-	1	1
Pensyarah IPG	1	-	1
Pegawai Pelajaran	2	-	2
Guru Sekolah	-	1	1
JUMLAH (orang)	8	4	12

b. Individu pakar mengikut pengalaman dalam bidang PTV

Pengalaman dalam bidang PTV merupakan salah satu kriteria pemilihan sampel kajian Delphi. Seramai lima orang sampel kajian Delphi memiliki pengalaman dalam bidang kepakaran masing-masing melebihi 30 tahun. Individu tersebut terdiri melibatkan tiga orang staf akademik IPTA, masing-masing seorang pegawai pelajaran dari Kementerian Pelajaran Malaysia dan seorang guru sekolah.Seterusnya seramai tiga orang peserta kajian Delphi memiliki pengalaman di antara 26 hingga 30 tahun.Mereka terdiri daripada dua orang staf akademik IPTA dan seorang lagi staf akademik dari IPTS.Selebihnya seramai empat orang peserta kajian Delphi memiliki pengalaman di antara 16 hingga 20 tahun.Mereka terdiri daripada dua staf akademik IPTA dan masing-masing seorang daripada pensyarah IPG dan pegawai pelajaran dari Kementerian Pelajaran Malaysia.Data tersebut juga menunjukkan bahawa mereka terdiri daripada kategori individu berpengalaman dalam bidang PTV di antara 16 hingga 31 tahun ke atas.

Secara keseluruhannya, pengalaman seorang peserta kajian amat mempengaruhi dapatan kajian ini kerana wujud perkaitan yang rapat di antara tahap pengetahuan dan kemahiran yang tinggi dengan kemampuan mereka untuk menyelesaikan sesuatu isu yang telah dikenal pasti. Jadual 1.2 menggambarkan kenyataan tersebut.

Jadual 1.2 Pengalaman dalam bidang kepakaran peserta kajian Delphi

Pengalaman Dalam Bidang PTV	**10 – 15 Tahun**	**16 – 20 Tahun**	**21 – 25 Tahun**	**26 - 30 Tahun**	**> 30 Tahun**	**Jumlah**
Gelaran Jawatan	**(orang)**	**(orang)**	**(orang)**	**(orang)**	**(orang)**	**(orang)**
Staf Akademik IPTA	-	2	-	2	3	7
Staf Akademik IPTS	-	-	-	1	-	1
Pensyarah IPG	-	1	-	-	-	1
Pegawai Pelajaran	-	1	-	-	1	2
Guru Sekolah	-	-	-	-	1	1
JUMLAH (orang)	-	4	-	3	5	12

Kesemua peserta kajian Delphi berpengalaman dalam pembentukan proforma mata pelajaran bercorak teknikal dan vokasional di peringkat sekolah menengah harian di Malaysia.Sebahagian daripada mereka terlibat mengajar bakal-bakal guru dalam bidang PTV dan menyumbang dalam pembentukan dasar atau polisi PTV dalam negara ini.

Analisis data temu bual kajian Delphi

Kaedah temu bual berstruktur telah dilaksanakan dalam sesi pusingan yang pertama dan data temu bual tersebut diproses secara berterusan sebaik sahaja data tersebut dikutip.Wellington (2000) berpandangan bahawa tindakan untuk memproses data dengan segera sebaik sahaja temu bual selesai dijalankan adalah baik agar pengkaji memahami fenomena kajian secara lengkap dan menyeluruh.Data yang diperoleh melalui temu bual adalah bersifat kualitatif yang akan melibatkan proses mencari dan menyusun data yang diperolehi secara sistematik. Selanjutnya data temu bual dalam kajian ini dianalisis melalui tiga prosedur iaitu mereduksikan data, membuat verifikasi dan mempersembahkan data (Miles dan Huberman (1994).

Verifikasi adalah satu prosedur penting dalam menganalisis data temu bual kajian Delphi yang telah dijalankan.Tujuan membuat verifikasi data temu bual adalah bagi menjamin kesahan

dan kebolehpercayaan dapatan data temu bual.Proses verifikasi tersebut dilaksanakan dengan mendapatkan "*inter-rater reliability*" terhadap kod dan unit dengan menggunapakai skala *Cohen Kappa* atau nilai Pekali Persetujuan Kappa. "*Inter-rater reliability*" berupaya untuk melahirkan sebuah kajian yang mantap dengan meningkatkan keobjektifan kajian dan mengurangkan keralatan serta memastikan konsistensi dalam dapatan sesuatu kajian (Coffey & Alkinson 1997; Fleiss 1981; Fraenkel & Wallen 2006).

Bertepatan dengan padangan tersebut, kajian ini telah melaksanakan proses pengesahan menerusi bantuan individu yang pakar dalam kajian kualitatif dan merujuk kepada rumusan Rust dan Cooil (1994) seperti mana dalam jadual 1.3.Ini bertujuan untuk menentukan tahap kesepakatan dalam kalangan panel pakar bagi menyetujui kebolehpercayaan kod dan unitnya. Melalui kaedah ini, persetujuan antara penilai akan ditransformasikan kepada nilai kebolehpercayaan. Mengikut pendapat Howait dan Cramer (2003), nilai yang melebihi 0.70 dianggap mempunyai nilai kebolehpercayaan yang tinggi.

Jadual 1.3 Skala nilai kebolehpercayaan Kappa

Kappa (K)	**Interprestasi**
K < 0.00	Sangat lemah
0.00 < K < 0.20	Lemah
0.21 < K < 0.40	Sederhana lemah
0.41 < K < 0.60	Sederhana
0.61 < K < 0.80	Baik
0.81 < K	Sangat baik

Sumber : Rust & Cooil 1994

Berikut merupakan rumusan dan kaedah jalan pengiraan yang dilakukan oleh pengkaji untuk mengira nilai persetujuan Kappa bagi kod dan unit data temu bual kajian ini.

$$K = (fa - Fc) \div (N - Fc)$$

di mana

K = Nilai Pekali Persetujuan Kappa/Cohen Kappa
Fa = Unit Persetujuan
Fc = 50% daripada jangkaan persetujuan
N = Unit Transkripsi (20)

Dalam kajian ini, persetujuan tiga penilai telah diperolehi daripada hasil penilaian mereka terhadap 20 unit yang wujud.Penggunaan 20 unit untuk mencari nilai persetujuan antara pakar adalah selari dengan kajian yang dilakukan oleh Zahrah (2002) dan Tam (1999). Setelah ketiga-tiga penilai memberi persetujuan proses pengiraan dilakukan dan nilai persetujuan antara penilai dalam kajian ini adalah 0.93 iaitu nilai yang tergolong dalam tahap skala kebolehpercayaan yang sangat baik berdasarkan jadual Rost dan Cooil (1994). Proses memperolehi nilai persetujuan Kappa ditunjukkan melalui jadual 1.4.

Jadual 1.4 Nilai persetujuan antara penilai

Penilai 1	Penilai 2	Penilai 3	Nilai Persetujuan Keseluruhan
K = 19-10	K = 20-10	K = 19-10	= 0.9 + 1.0 + 0.9
20-10	20-10	20-10	3
= 0.9	**= 1.0**	**= 0.9**	**Kappa = 0.93**

Justeru, keputusan nilai persetujuan Kappa tersebut membolehkan pengkaji untuk meneruskan penganalisisan data dalam langkah-langkah selanjutnya.Hasil dari analisis dan keputusan nilai persetujuan Kappa, sebanyak 20 indikator kelestarian PTV sekolah menengah harian di Malaysia telah dikenal pasti.Sebanyak 20 indikator kelestarian PTV telah dikenal pasti dan dipersetujui oleh peserta kajian atau panel pakar yang terlibat dalam kajian Delphi. Indikator kelestarian PTV sekolah menengah harian yang telah tersebut ialah pengetahuan guru, kemahiran teknikal guru, kaunselor, komitmen pihak pengurusan, program pembangunan staf, internships dan kerjasama industri, rangkaian dan perkongsian, artikulasi, kemahiran insaniah, latihan berasaskan keterampilan, kaedah pengajaran guru, keusahawanan, input industri, pengiktirafan, kreativiti guru, inovasi guru, kecenderungan pelajar, kreativiti pelajar, inovasi pelajar dan kemahiran ICT.

PERBINCANGAN

Kelestarian adalah satu paradigma pemikiran masa hadapan bagi tujuan peningkatan kualiti kehidupan atau penaiktarafan kehidupan seperti yang ditegaskan oleh Ruhizan dan Norzaini (2005).Di samping itu, definisi yang telah diberikan oleh Dewan Bahasa dan Pustaka (2007) kelestarian bermaksud kekal, terpelihara hingga bila-bila. Gabungan antara kedua-dua maksud atau definisi tersebut pengkaji telah mengkonsepkan bahawa kelestarian PTV adalah satu usaha yang perlu agar ianya kekal atau terpelihara dalam konteks pelaksanaan di sekolah menengah harian untuk meningkatkan kualiti hidup generasi sekarang dan akan datang. PTV perlu dilestarikan agar matlamat negara mencapai status negara berpendapatan tinggi tercapai seperti yang termaktub dalam RMK-10.

Hasil dapatan kajian Delphi melalui temu bual adalah berdasarkan tujuh strategi kelestarian PTV yang telah dicadangkan oleh UNEVOC (2004).Protokol temu bual yang digunakan oleh pengkaji dalam kajian Delphi telah berpandukan tujuh strategi tersebut dan menghasilkan 20 indikator kelestarian MPV sekolah menengah harian.Beberapa indikator kelestarian PTV sekolah menengah harian seperti pengetahuan guru, kemahiran teknikal guru, latihan berasaskan keterampilan adalah selari dengan kajian yang dijalankan oleh PPTV, KPM (2002), Hajar (2008), BPPDP, KPM (2006) dan Mohd Nordin (2011). Ini menunjukkan aspek pengetahuan, kemahiran dan kompetensi amat penting khususnya kepada guru-guru PTV sebagai pelaksana di sekolah menengah harian.

Di samping itu indikator lain seperti yang dihasilkan melalui kajian Delphi iaitu strategi pengajaran guru dan kaunselor adalah selari dengan kajian yang dijalankan oleh PPTV, KPM (2002). Manakala indikator internships dan kerjasama industri dan kursus peningkatan keilmuan atau program pembangunan staf merupakan indikator yang sama dalam kajian Mohd Nordin (2011).

Akhirnya, indikator seperti komitmen pihak pengurusan, rangkaian dan perkongsian, artikulasi, kemahiran insaniah, keusahawanan, input industri, pengiktirafan, kreativiti guru dan pelajar, inovasi guru dan pelajar, dan kemahiran ICT adalah merupakan penemuan baru dalam kajian ini yang bersandarkan strategi kelestarian PTV oleh UNEVOC (2004). Penghasilan 20 indikator kelestarian PTV sekolah menengah harian melalui kajian Delphi diharapkan pelaksanaan PTV di sekolah menengah harian akan lebih mapan dalam mencapai objektif dan matlamat serta visi negara.

PENUTUP

Kelestarian PTV di sekolah menengah harian akan menjadikan PTV ini terus kekal atau mapan selari dalam usaha kerajaan memartabatkan pendidikan teknikal dan vokasional. Ini selaras dengan hasrat menuju negara menjadi sebuah negara berpendapatan tinggi seperti yang termaktub di dalam RMK-10.Dapatan kajian yang dilaksanakan, diharapkan dapatannya berupaya untuk menyumbang kepada khazanah ilmu menerusi sumbangan atau implikasi terhadap dasar dan pendidikan teknikal dan vokasional di peringkat sekolah menengah.Di samping itu juga, kajian lanjutan diharapkan dapat membantu meningkatkan lagi kualiti dapatan kajian ini agar khazanah pendidikan yang sentiasa di*update*dan dirujuk oleh pewaris ilmu.

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Asnul Dahar Bin Minghat
Fakulti Pendidikan, Universiti Teknologi Malaysia, Johor Bahru, Johor.
asnul@utm.my
+60137280015

Ruhizan M.Yasin
Fakulti Pendidikan, Universiti Kebangsaan Malaysia, Bangi, Selangor.
ruhizanmy@gmail.com

4

Evaluation Criteria of Technology Park: A Study on Malaysia Technology Park

Norlena Hasnan, Che Sobry Abdullah, Shahimi Mohtar
Nor Hasni Osman, Faisal Zulhumadi & Rahimi Abidin

ABSTRACT

While the increasing number of technology parks and the research conducted on their performance, there is still uncertainty about whether technology parks are achieving their goals and exactly what their impact is on their tenants. The impact of technology park services is still unknown. There is a gap in our knowledge about how an organization develops in the protected environment of a technology park. This paper provides information on the performance of technology parks in Malaysia by exploring the operation of the first integrated technology park in Malaysia, Kulim Hi-Tech Park (KHTP). It incorporates the tenants of the technology park to examine the performance evaluation criteria of the technology park. Data were collected from a field survey. Data analysis from the survey shows that the technology park has all the evaluated criteria and these criteria have different categories of impact on the tenants. The construct of technology parks role and performance could be extended to cover more issues that might be related to the current practice in the industry.

Keywords: *Technology parks, high-tech firms, technology park services*

ABSTRAK

Walaupun jumlah taman teknologi dan penyelidikan yang dijalankan ke atas prestasi mereka semakin bertamabh, masih terdapat ketidakpastian mengenai sama ada taman teknologi ini berjaya mencapai matlamat mereka dan apa kesannya kepada penyewa mereka. Impak perkhidmatan yang disediakan oleh taman teknologi bagi menyokong kemajuan institusi masih tidak diketahui. Terdapat jurang dalam pengetahuan kita tentang bagaimana organisasi yang tertubuh dalam persekitaran yang dilindungi di taman teknologi. Artikel ini menyediakan maklumat mengenai prestasi taman teknologi di Malaysia dengan meneroka operasi taman teknologi bersepadu pertama di Malaysia, Kulim Hi-Tech Park (KHTP). Kajian in melibatkan penyewa taman teknologi bagi meneliti kriteria penilaian prestasi taman teknologi. Data-data dikumpul daripada kajian lapangan. Analisis ke atas data yang diperoleh daripada kajian menunjukkan bahawa taman teknologi mempunyai semua kriteria yang dinilai dan kriteria ini mempunyai kategori yang berbeza dalam memberi kesan kepada penyewa. Peranan teknologi taman teknologi dan prestasi daripada kajian ini boleh dilanjutkan untuk meliputi lebih banyak isu-isu yang mungkin berkaitan dengan amalan semasa dalam industri.

Keywords: taman teknologi, syarikat berteknologi tinggi, perkhidmatan taman teknologi.

INTRODUCTION

The development of technology parks typically generates the expectations that they will contribute significantly to the industrialization. The terms of "technology parks", "science parks", "research parks", "industrial parks" and "innovation parks", etc. have always been used interchangeably in past studies (Monck et al., 1988; Link and Scott, 2002; Chen and Huang, 2004; Palmai, 2004; Vedovello, 2007). Generally, the terms refer to clustering of industries designed to meet compatible demands of different companies within one location.

The physical layout can be described as tract of land developed and subdivided into plots or zones according to a detailed plan equipped with roads, transport and public utilities for the use of a group of industrialists. Given the necessary support of infrastructure and facilities in the technology park, the companies expected to obtain benefit from economic of scale. In addition, the comprehensive services provided will necessitate diversified effects on the surrounding region and finally, stimulate regional development.

The development of Malaysia technology parks are closely related to the five-yearly programs of Malaysia Plan. In the Eight Malaysia Plan (2001-2005), the Malaysian Government was looking at the knowledge-economy as the basis of every spectrum of the nation's development. This is continued further in the Ninth Malaysia Plan (2006-2010) and Malaysia's Outline Perspective Plan (OPP 3, 2000-2010). Based on these plans, the government is continuing its effort to develop competitive and resilient SMEs that are equipped with strong technical and innovation capacity as well as managerial and business skills.

In the recent Tenth Malaysia Plan (2011-2015), the government sets the stage for a major structural transformation that a high-income economy requires. The plan details strategies towards a more focused role for the government as a regulator and catalyst and programmes that enable the country to emerge as a high income nation, as envisioned in Vision 2020. The foundation of any productive high income economy lies in a globally competitive, creative and innovative workforce. Hence, it requires an integrated approach to nurturing, attracting and retaining first world talent base (10^{th} Malaysia Plan).

KULIM HI-TECH PARK

Kulim Hi-Tech Park (KHTP) situated in south Kedah, 40 kilometres from the island of Penang, Malaysia, offers 4,200 acres of development with a strategic location, support facilities, and human resources for high-tech manufacturing and research and development (R&D) activities. As the first comprehensive high-technology park, KHTP has created its own unique environment. The technology park is attracting the attention of diverse tech industries, including biotech, aerospace, alternative energy, and optoelectronics with its city-within-a-park paradigm that includes a fire department, police station, mosque, restaurants, and hospitals.

One of its important tenant companies, First Solar has already begun exporting its thin film solar modules and is further expanding its plants in Kulim High-Tech Park. The company is investing $680 million in the manufacturing plant and expected to achieve cost reductions through economies of scale in a high-quality manufacturing environment. Apparently the openness and business practice of KHTP had yielded positive results in foreign direct investments to this country (Hasnan et. al, 2012).

The increasing globalization, strategic alliances with overseas companies in capital intensive and high technology industries are vigorously promoted by the government. This significantly increases the role of KHTP in the Malaysian economy. Wafer fabrication is actually the main activity of KHTP. It is of strategic importance in the country's industrialization drive as it is a core technology of the semiconductor industry. The establishment of wafer fabrication plants is expected to promote the development of high technology in Malaysia. The 1,700 hectare park targets technology-related industries, primarily in the fields of advanced electronics, telecommunications, biotechnology, advanced materials, research and development and emerging technologies.

TECHNOLOGY PARK SERVICES

It is widely believed that technology parks can provide a nurturing environment for new business start-up and therefore, leading to later development of growth-oriented firms (Robani, 2008). The synergy between and among high tech firms can be generated through the structural elements provided by the incubator such as infrastructure and supporting facilities (Maillat, 1995; Phillimore, 1999). Generally, these services divided into basic structural support and technology-specific structural support. Common examples of basic structural support include shared office services, business assistance, rental breaks, business networking, access to capital, legal and accounting aid, and advice on management practices (Mian, 1997; Smilor, 1987; Harwit, 2002). Technology-related structural support features the following services: laboratory and workshop facilities (Mian, 1997), mainframe computers (Chan & Lau, 2005), research and development activities (Doutriaux, 1987), technology transfer programs (Smilor, 1987) and advice on intellectual property (OECD, 1999).

Although the increasing number of technology parks and the research conducted on their performance, there is still uncertainty about whether technology parks are achieving their goals and exactly what their impact is on their tenants. The impact of differing institutional backers is still unknown. There is a gap in our knowledge about how an organization develops in the protected environment of a technology park (Hasnan et. al, 2010).

Strategy researchers have integrated the three organizational perspectives and developed performance measures in terms of multiple hierarchical constructs (Venkatraman and Ramanujam, 1986). The first is financial performance in terms of organizational effectiveness (Chakravarty, 1986). The second is organizational effectiveness measured by product quality and market share. Financial performance measures allow for competitive analysis where firms compare financial data regarding market share, sales, production costs or the budgets of competitors (Yasin, 2002).

Performance evaluation provides responses to questions such as whether, how and why an organization succeeds. These approaches work well when applied to the corporate environment where long terms data can be analyze and compare with other organizations. However, the problems inherent in small firm research confront those attempting to apply these theoretical perspectives to research into incubators and their tenants (Remedios and Cornelius, 2003). On the other hand, non-financial operational performance measures have been use in small firm research (Murphy *et al*., 1996). Given that it is problematic to collect financial data from new ventures or small businesses, operational measures form a suitable base for building a framework for measuring the performance of start-ups located in incubators.

Mian (1997) proposed an integrated framework for the assessment of the performance of university technology incubator after reviewing and summarizing the salient features of four selected approaches to the incubator, i.e. goal approach, system resource approach, stakeholder approach and internal process approach. In this model, three sets of variables identified based on the related literature: (a) performance outcomes, (b) management policies and their effectiveness, and (c) services and their value-added. Chan and Lau (2005) modified the comparative evaluation approach to capture the effects on technology firms throughout the venture development path.

Based on the literature review, which discussed on the purpose of the establishment of technology parks and the function of these incubation areas, it was found that several evaluation criteria can be utilized to determine the technology park performance from tenants' perspective. They can be categorized as follows:-

a. Provide pooling resources (staff training, marketing event and exhibition)
b. Provide consulting/counselling services
c. Assist in reducing cost
d. Assist in funding.
e. Provide sharing resources (laboratory, testing equipment, meeting rooms, etc.)
f. Facilitate in creating good image
g. Facilitate in creating networking
h. Present advantages of clustering
i. Present advantages of geographical proximity

METHODOLOGY

A set of close ended questionnaire was developed in order to gather data on the nine evaluation criteria. The questionnaire contains a total of 44 questions that are divided into three sections. The three sections asked questions on the background details of the respondent and the firm, the nine criteria of technology park performance, and the challenges or barriers faced by their organization operating in this technology park.

The survey on the performance criteria involved a sample of industrial tenants operating in the technology park. The unit of analysis chosen is the company whereby the data was collected using survey method from the target respondents at the managerial level. These people were chosen because they are close to the decision- making involving the transfer of technology and they were involved in employee development.

There are a total of 53 companies operating in Kulim Hi-Tech Park. Based on Krejcie and Morgan Table (1970)., a sample of 44 companies is needed in order to get result that reflects the target population with 95 percent of confidence level and confidence interval of 5. By the use of simple random sampling procedure the questionnaires were distributed to the selected companies. However, only 32 completed questionnaires were received and give in 73 percent response rate. This response rate was quite reasonable compare to previous studies on the tenants of technology parks, for example 35 percent (21 companies out of 60 companies) in Vedovello (1997). The data from the survey of this study can be analyzed with 95 percent of confidence level and with a wider confidence interval that is 18.

RESULTS AND FINDING

The respondents involved in this study are managers and directors or CEOs of the companies. 43.8 per cent of the respondents have less than five years in their designations, 15.6 per cent have between five to ten years, and three respondents have more than five years experience. Table 1 shows the breakdown of this demographic.

Table 1 Number of years of experience in the current position.

Number of Years	Frequency	Percent
Less than 5 years	14	43.8
Between 5 to 10 years	13	40.6
More than 10 years	5	15.6
Total	32	100.0

In terms of company size from the employee perspective, 28.1 percent of the companies have less than 50 employees, while 21.9 percent have more than 500 employees. The breakdown of number of employees in the companies is shown in Figure1.

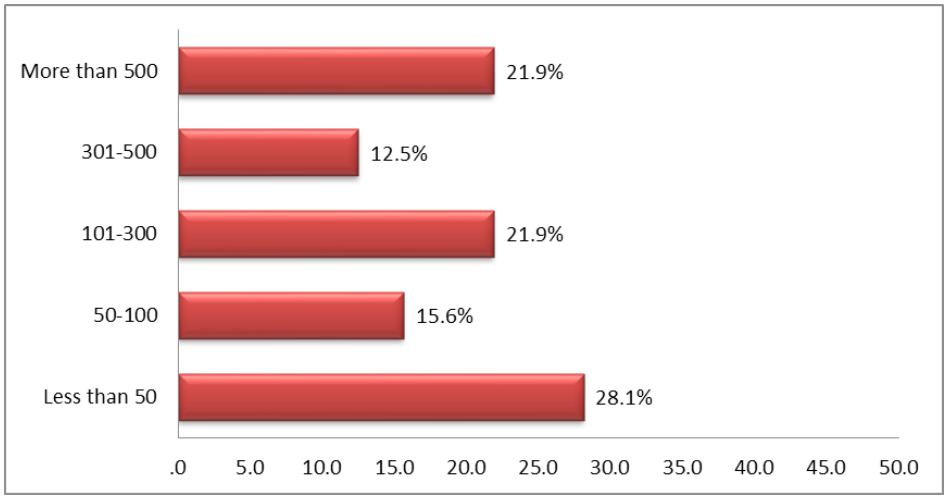

Figure 1 Number of Employees

The companies involved in the studies can be divided into three types of – local, multinational and joint-venture as shown in Figure 2. It shows that majority of the respondents (41%) are from multinational companies, followed by local (25%) and joint-venture (25%). These companies are from various fields of high technology industries. The types of industries are listed in Table 2.

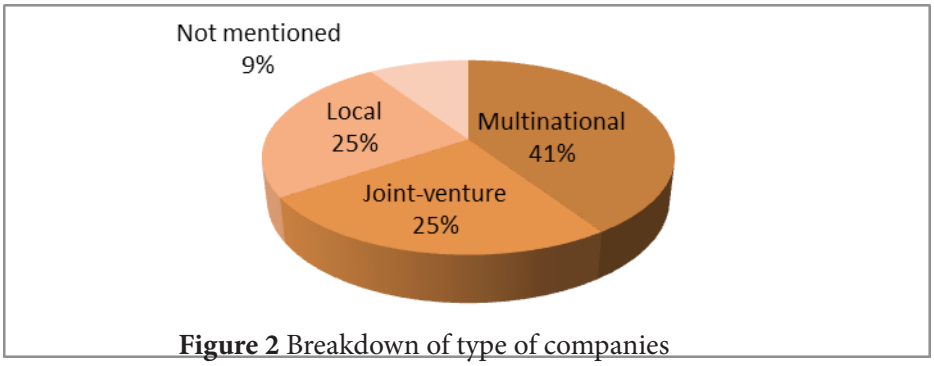

Figure 2 Breakdown of type of companies

These companies are from various fields of high technology industries. The types of industries are listed in Table 2.

Table 2 Field of Industries

No.	Industries
1	advanced electronics
2	biotechnology
3	chemical
4	hard mask blanks
5	industrial gases and services
6	mechanical electronics
7	medical and scientific instruments
8	medical device manufacturing
9	microelectronics
10	photo-electronics
11	semiconductors
12	wafer fabrication

The respondent were asked to rate the impact of the criteria on their companies with a scale ranged from zero to hundred. The mean score of each criterion is categorized into five groups as shown in Table 3.

Table 3 Description of mean score

Mean Score	**Actual Rate (%)**	**Category**
0 – 2.0	0 – 20	Very Low
2.1 – 4.0	21 – 40	Low
4.1 – 6.0	41 – 60	Moderate
6.1 – 8.0	61 – 80	High
8.1 – 10	81 – 100	Very High

Descriptive statistics have been used to describe the basic features of the data in a study. The statistic provides simple summaries about the sample and the measures. The descriptive results enable the researchers to identify the dispersion of the data. Dispersion refers to the spread of the values around the central tendency. There are two common measures of dispersion, the range and the standard deviation. The Standard Deviation is a more accurate and detailed estimate of dispersion because an outlier can greatly exaggerate the range. The consistency of data has been tested to identify the consistencies of the variables. As show in Table 4, the alpha values of reliability analysis for this study range from 0.655 to 0.935. This signifies that misunderstanding is most unlikely to take place. From the results obtained, all the alpha values are greater than 0.6. Thus it can be concluded that this instrument has internal consistency and is therefore reliable.

Table 4 Descriptive statistics of the evaluation criteria

	Number of items	Median	Mean	Std. Deviation	Alpha
Pooling Resources (PR)	3	5	4.67	1.41	0.655
Consulting Services (CS)	3	5	4.64	1.36	0.856
Cost Services (C)	4	5	4.57	1.23	0.769
Funding Support (FS)	3	5	5.00	1.62	0.876
Sharing Resources (SR)	4	5	4.89	1.61	0.919
Public Image (PI)	3	5	5.45	1.60	0.780
Networking (N)	6	5	5.14	1.39	0.911
Clustering (CL)	3	6	6.18	1.69	0.935
Geographic Proximity (GP)	3	5	5.59	1.16	0.660

From the survey, it was identified that KHTP has all the evaluation criteria. However, the impacts of these criteria on the incubating companies are different. Figure 2 shows the illustration of the existing impact of evaluation criteria on the incubating companies. It is found that the highest criterion is clustering. The overall mean score of this criterion is 6.1 or 61 percent actual rate. It can be considered as in high category. Besides, the other criteria are in moderate category. Those are graphical proximity (55.9% actual rate), public image (54.5% actual rate), sharing resources (48.9% actual rate), networking (51.4% actual rate), funding support (50% actual rate), consulting services (46.4% actual rate), pooling resources (45% actual rate) and cost subsidies (45.7% actual rate).

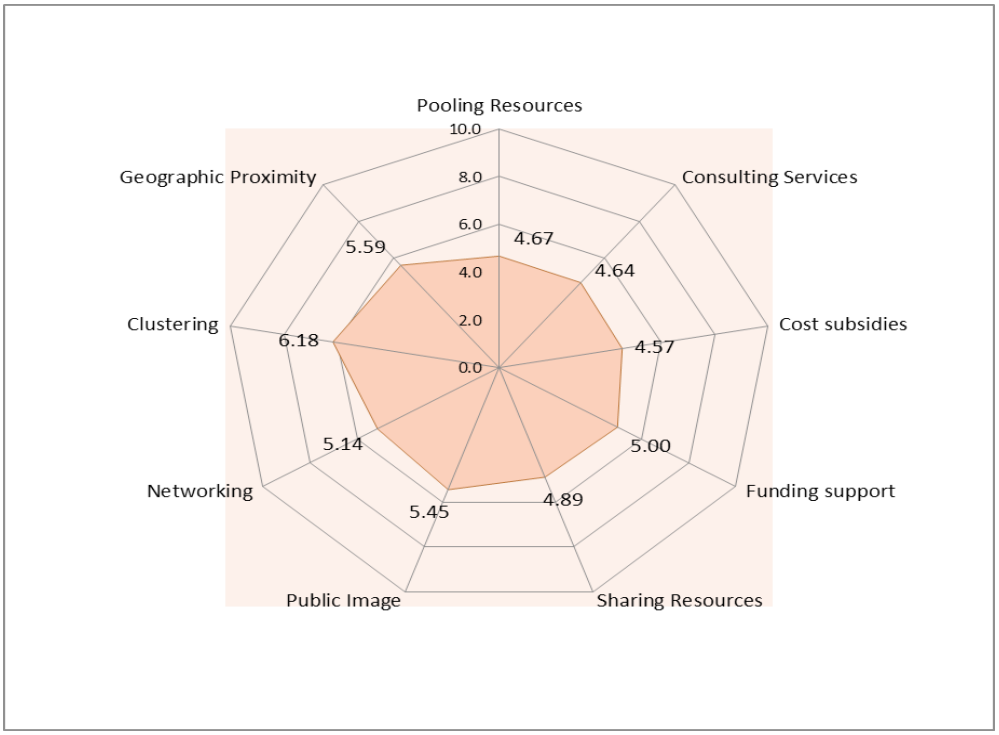

Figure 2 The Evaluation Criteria on the Incubating Companies

DISCUSSION

It appears that the services provided by the technology park are able to contribute in business development of the incubating companies. However, the results presented indicate that the impacts of technology park services in terms of the evaluation criteria are different. Among the criteria that obtain high score are clustering and geographic proximity. Apparently the being located at KHTP provides the tenants the advantage of obtaining services and supplies from well-established companies in this area. KHTP is well-connected, in terms of its road network as there are an expressway that provides easy access between KHTP to the North Butterworth Container Terminal (NBCT) seaport, North-South Expressway and to the Penang International Airport on the Penang Island, via the Penang Bridge. Being located at the high-tech park provides the companies with proximity to a good pool of readily available skilled and semi-skilled human resources for their operations. This really means that the work force around this location is accustomed to working in, as well as having sufficient knowledge and skills in, the technology industry.

On the other hand, in terms of pooling resources, funding supports and cost subsidies the technology park services have low impact on the tenant. This results obtained might be because of the services provided are depending on the size of the companies. Although one of the main criteria driving the decision to establish company in KHTP is the low cost of doing business with high technology facilities, certain services only available for companies with certain criteria.

CONCLUSION

KHTP has increasingly being recognized by multinational corporations (MNCs) including those from Japan, the United States, Germany, Singapore and West Asia. Due to its competitiveness, it is not surprising that KHTP will be the forefront of Malaysia's drive to become a globally-recognized centre of technological excellence.

It is moving forward to be one of the best high-tech parks in the region. Nevertheless, to offer more value added to the tenant companies and to the nation as a whole, KHTP should always monitor its position and clearly understand the direction. Appropriate strategies and mechanism are needed to overcome the obstacles faced. A continuous program for assessment of the dimensions of KHTP could be very important in order to identify the reasons and their challenges faced within the technology parks that lead to increase the competitive capabilities. It can be concluded that there is still more opportunity to improve in ensuring the competitiveness of the technology park.

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Norlena Hasnan[1]
Che Sobry Abdullah[2]
Shahimi Mohtar[3]
Nor Hasni Osman[4]
Faisal Zulhumadi[5]
Rahimi Abidin[6]
School of Technology Management and Logistics College of Business
Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia
[1]norlena@uum.edu.my, [2]sobry@uum.edu.my,
[3]shahimi@uum.edu.my, [4]has1218@uum.edu.my,
[5]faisal@uum.edu.my, [6]rahimiabidin@gmail.com

5

Bio-mediated Soil Improvement and Its Potential Application for Slope Stabilization

Lee Min Lee

ABSTRACT

Bio-mediated soil improvement has recently emerged as a new and sustainable soil improvement technique. This paper aims to determine preferable bio-treatment conditions in a typical tropical residual soil. A species of *Bacillus* group, *B. megaterium* was used to trigger calcite precipitation. The treatments were performed at various cementation reagent concentrations, treatment durations, and flow pressures. Results showed that the preferable bio-treatment conditions for the residual soil were: 0.5 M reagent concentration, 1.1 bar flow pressure, and 48 hours treatment duration. The shear strength improvement and saturated permeability reduction obtained from this combination of treatment parameters were 69 % and 90 %, respectively. For shear strength improvement, calcite are required to be precipitated at the particles contact points, whereby no specific binding of soil particles are required for reducing the saturated permeability. The potential application of the bio-mediated soil for slope stabilization was evaluated. It was anticipated that the bio-mediated soil could improve the performance of the existing capillary barrier system by increasing the water retention ability of the upper fine-grained layer, and minimizing the potentials of sliding failure and erosion.

Keywords: Bio-mediated soil, microbially induced calcite precipitation, soil improvement, slope stabilization, residual soil

INTRODUCTION

Bio-mediated soil improvement is a relatively new and innovative technique of soil improvement. The technique takes advantages of natural bio-activities, technically termed as microbially induced calcite precipitation (MICP), to produce calcite in soil matrix. The calcite generated is responsible for cementing and clogging soil particles, and hence improving their inherent engineering properties. The MICP process has also shown promising applications in other construction materials, i.e. improvements of strength (Siddique et al., 2008; Raijiwara et al., 2009) and durability (De Muynck et al., 2008; Achal et al., 2011) of concrete / mortar, and durability of brick (Sarda et al., 2009).

The chemical reactions involved in the process of MICP is expressed as follows:

$$CO(NH_2)_2 + 2H_2O \rightarrow 2NH_4^+ + CO_3^{2-} \quad [1]$$

First, urea ($CO(NH_2)_2$) and water (H_2O) are decomposed into ammonium (NH_4^+) and carbonate (CO_3^{2-}) ions with the presence of urease enzyme. This process is scientifically known

as urea hydrolysis. It is important to supply urease positive type bacteria, i.e. genera *Bacillus*, *Sporosarcina*, *Spoloactobacilus*, *Clostridium* and *Desulfotomaculum* (Kucharski et al., 2008) into soil to promote the production of urease enzyme, and hence the urea hydrolysis process .

The release of ammonium (NH_4^+) in the Eq. [1] is essential for increasing the pH of soil as the subsequent calcite precipitation process favors a slightly alkaline environment. The carbonate (CO_3^{2-}) ions will react with the calcium ion (Ca^{2+}) from the supplied calcium chloride to form calcium carbonate or calcite ($CaCO_3$):

$$Ca^{2+} + CO_3^{2-} \rightarrow CaCO_3 \quad [2]$$

The calcite ($CaCO_3$) precipitated is responsible for improving inherent engineering properties of soil through biocementation and bioclogging. Biocementation is defined as an improvement of soil strength by production of particle-binding materials through microbial means, while bioclogging is a reduction of hydraulic conductivity of soil or porous rock by pore-filling materials generated by microbial processes (Ivanov and Chu, 2008).

The bio-mediated soil improvement has been widely recognized as a 'greener' and more sustainable soil improvement technique than the conventional chemical grouting method. From the Eqs. [1] and [2], it is apparent that the MICP process requires the supply of three main ingredients / materials, namely urea ($CO(NH_2)_2$), calcium chloride, and urease positive bacteria. None of these materials are toxic or hazardous to human health and soil organisms. The treatment process involves a relatively straight forward chemical process, regulated mainly by four key factors: (i) concentration of calcium ion, (ii) concentration of dissolved inorganic carbon (DIC), (iii) pH and (iv) availability of nucleation sites (Kile et al., 2000, Ng et al., 2012).

The state of the art research of bio-mediated soil improvement has focused primarily on fine sands, while very little studies on other soil types (DeJong et al, 2006). *S. pasteurii* has been widely used as the urease-producing microorganism in the existing MICP treatment (DeJong et al., 2006; Harkes et al., 2010; Martinez et al., 2011; Stocks-Fischer et al., 1999). Studies on alternative species of bacteria are still very limited. In addition, studies on the effectiveness of the bio-mediated soil have been thus far limited to small scaled laboratory tests (DeJong et al., 2006; Whiffin et al., 2007; DeJong et al., 2010). The performance of the bio-mediated soil at actual field is still unclear, despite there were several attempts in Netherlands experimenting on scale-up laboratory and field models (van Passen, 2011). These research gaps form the basis of the present study.

This paper aims is to investigate performance of the bio-mediated soil improvement technique in a typical tropical residual soil (sandy silt). Urease enzyme was produced by *Bacillus megaterium* (ATCC 14581). Effectiveness of the MICP treatment was evaluated by direct measurements of unconfined compressive strength and saturated permeability of the soil specimens. Potential application of the bio-mediated soil for slope stabilization are also discussed in the latter part of this paper.

MATERIALS AND METHODS

Laboratory Setup

Fig. 1 shows a schematic diagram of the experimental setup for MICP treatment. The apparatus comprised a steel mold of 50 mm in diameter and 170 mm in length, an air compressor, a pressure

tank, and an effluent collector. Air-dried residual soil was first mixed with a culture medium containing urease-producing microorganism. The soil specimen was then compacted into the steel mold to a dry density of 1519 kg/m^3 (90 % of the maximum dry density). The specimen mold was connected to the pressure tank that filled with cementation reagent solutions. The pressure in the pressure tank was regulated by the air compressor to control the flow pressure into the specimen mold.

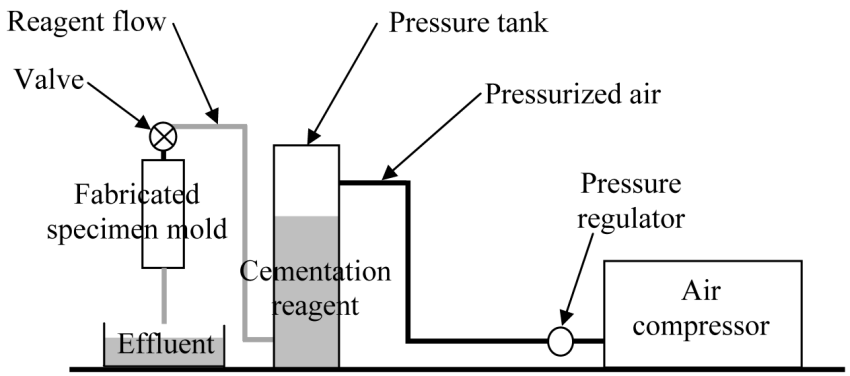

Fig. 1: Schematic diagram of the laboratory setup

Residual Soil Specimen

The tropical residual soil used in the present study was extracted from a site in the Universiti Tunku Abdul Rahman, Kuala Lumpur campus. Table 1 tabulates the values of physical indices of the soil specimens obtained from the standard soil properties tests. Based on the Unified Soil Classification System (USCS), the soil was classified as Sandy SILT. It is a typical residual soil that can be found in abundance in Malaysia.

Table 1: Properties of residual soil

Properties	**Values / Indices**
Composition	
Gravel (%)	0
Sand (%)	38
Silt (%)	43
Clay (%)	19
Liquid Limit (%)	40.4
Plastic Limit (%)	25.9
Plasticity Index	14.5
Soil Classification USCS	ML (Sandy Silt)
Maximum Dry Density (MDD)	1688.5 kg/m^3
Optimum Moisture Content (OMC)	16.6 %
Unconfined Compressive Strength, q_u (kPa)	76
Saturated Hydraulic Conductivity, k_{sat} (m/s)	5.4×10^{-8}
Carbonate Content (%)	0.7

Microorganism and Growth Conditions

The urease-producing microorganism used in the present study was *Bacillus megaterium* (ATCC 14581). The *B. megaterium* was cultivated at pH 7 under aerobic batch conditions in a sterile culture medium of 5 g/l peptone, 5 g/l sodium chloride, 2 g/l yeast extract, and 1 g/l beef extract. Incubation was performed in a shaking incubator at 200 rpm and constant temperature of 37°C. It was grown to early stationary phase before harvesting at a concentration of approximately 1×10^8 cfu/ml.

Cementation reagent Solutions

The cementation reagent for the MICP treatment consisted of an equimolar ratio of urea and calcium chloride, and 3 g/l of nutrient broth supplement.

Soil Engineering Properties Tests

Upon completion of the MICP treatment, the specimen mold was attached to a standard falling head permeability test setup to measure the saturated permeability (k_{sat}). Subsequently, the soil specimen was trimmed to 100 mm in height and 50 mm in diameter for performing unconfined compression test.

Calcite Content Determination

Gravimetric analysis using the acid-treatment weight loss technique was adopted to quantify the amount of calcite precipitated in the soil specimen. Hydrochloric acid (2 M) was used to wash through the soil specimen. Reactions between the hydrochloric acid and the calcite resulted in a loss of sample weight. The weight loss was used to estimate the percentage of calcite content in the soil specimen.

Treatment Variables

Three treatment variables were considered in this study: (i) concentration of cementation reagent, (iii) treatment duration, and (iv) flow pressure of cementation reagent. The values of these variables are tabulated in Table 2. The concentration of *B. Megaterium* for all the experiments was fixed at 1×10^8 cfu/ml.

Table 2: MICP treatment variables

Flow Pressure (Reagent concentration fixed at 0.5 M, Treatment duration fixed at 48 h)	**Treatment Duration** (Reagent concentration fixed at 0.5 M, Flow pressure fixed at 1.1 bar)	**Reagent Concentration** (Treatment duration fixed at 48 h, Flow pressure fixed at 1.1 bar)
0.2 bar	24 hours	0.25 M
1.1 bar	48 hours	0.5 M
2.0 bar	72 hours	1.0 M

RESULT & DISCUSSION

Shear Strength Improvement of Bio-mediated Soil

Fig. 2 shows the shear strengths of bio-mediated soils treated under various treatment conditions. With respect to flow pressure, it was evident that the specimen treated with a low flow pressure (0.2 bar) encouraged a higher shear strength development than those of high flow pressures. In actual field applications, considerations should be given to issues associated with the injection distance of the cementation reagent. The low flow pressure may result in a short injection distance, and hence increase the required number of injection well for a site. At an excessively high flow pressure (i.e. 2.0 bar), the shear strength of soil was lower than that of original control sample. A plausible explanation to this observation is that the high flow pressure may lead to a buildup of pore-water pressure in soil due to clogging of the soil body and mold outlet, and eventually result in a decrease in the effective stress. The high hydraulic gradient may also result in detachment of soil particles or disturbance of soil structures, and hence reduce the soil strength. Therefore, a flow pressure in between 0.2 and 2 bar (i.e. 1.1 bar) was recommended for the residual soil treatment.

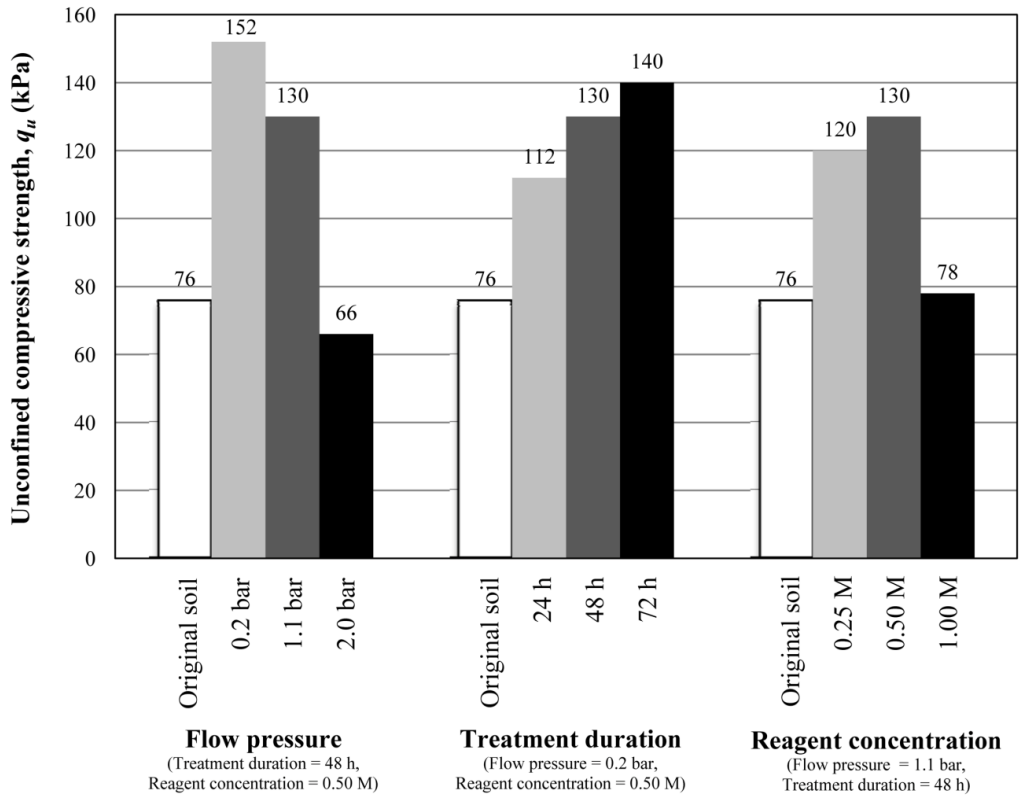

Fig. 2: Shear strengths of bio-mediated soils treated under various treatment conditions

Longer MICP treatment duration produced greater shear strength improvement. The results suggested that improvements (34 – 47 %) were primarily developed within the first 24 hour of treatment. The second 24 hour of treatment contributed to an additional improvement of 23 %. The contribution from the third 24 hours (12 – 13 %) was the lowest. The results implied that the effective MICP treatment duration was within the first 48 hours.

High salinity (i.e. 1.0 M) is not favorable for the growth of *B. Megaterium* (Nekolny and Chaloupka, 2000). As the result, treatments with 1.0 M cementation reagent did not show any measureable changes in shear strength. The highest shear strength was achieved at 0.5 M of cementation reagent.

Saturated Permeability Reduction of Bio-mediated Soil

Fig. 3 shows the saturated permeability of bio-mediated soils treated under various treatment conditions. With respect to flow pressure, the 1.1 bar specimen experienced the greatest reduction in saturated permeability. The excessively high flow pressure (i.e. 2.0 bar) has flushed out the bacteria in soil resulting in a low calcite precipitation, and hence a low reduction in saturated permeability.

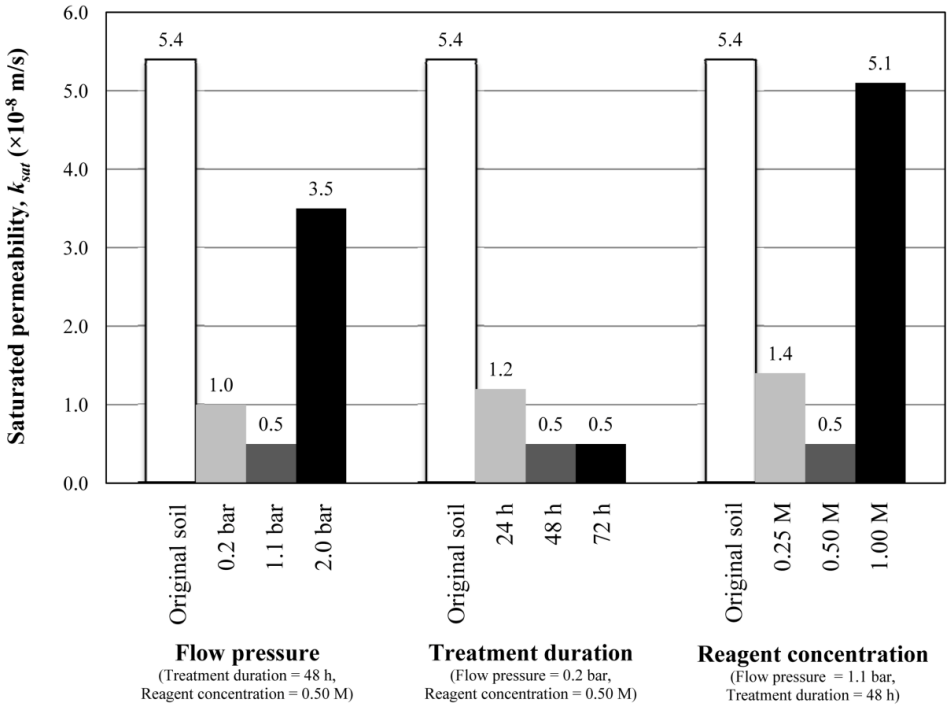

Fig. 3: Saturated permeability of bio-mediated soils treated under various treatment conditions

The saturated permeability of bio-mediated soils for different treatment durations showed good comparisons with the shear strength results. The reduction rate of saturated permeability decreased with the increased treatment duration. The saturated permeability reduction trend for different concentrations of cementation reagent was also consistent with the results of shear strength. The concentration of 0.50 M was recommended for the MICP treatment.

Calcite Content of Bio-mediated Soil

Fig. 4 shows the calcite content of bio-mediated soils treated under various treatment conditions. It is generally accepted that the reduction of soil saturated permeability was proportional with the amount of calcite precipitated. The reduction of saturated permeability in soil matrix is mainly attributed to the clogging of calcite in pore spaces or pore throats. No specific binding of soil particles are required for obstructing the water flow. On the contrary, the shear strength

improvement of bio-mediated soils exhibited a different mechanism from the saturated permeability reduction. For instance, the calcite content of 1.1 bar specimen was higher than the 0.2 bar specimen. However, the 0.2 bar specimen recorded a relatively higher shear strength than that of 1.1 bar specimen. An effective shear strength improvement requires the calcite to be formed at the particles contact points. Therefore, an increase in calcite content may not necessary be linearly correlated with the shear strength improvement considering some portions of the calcite may be precipitated on the soil particle surface or in the soil pores which are ineffective at promoting strong bonds between soil particles.

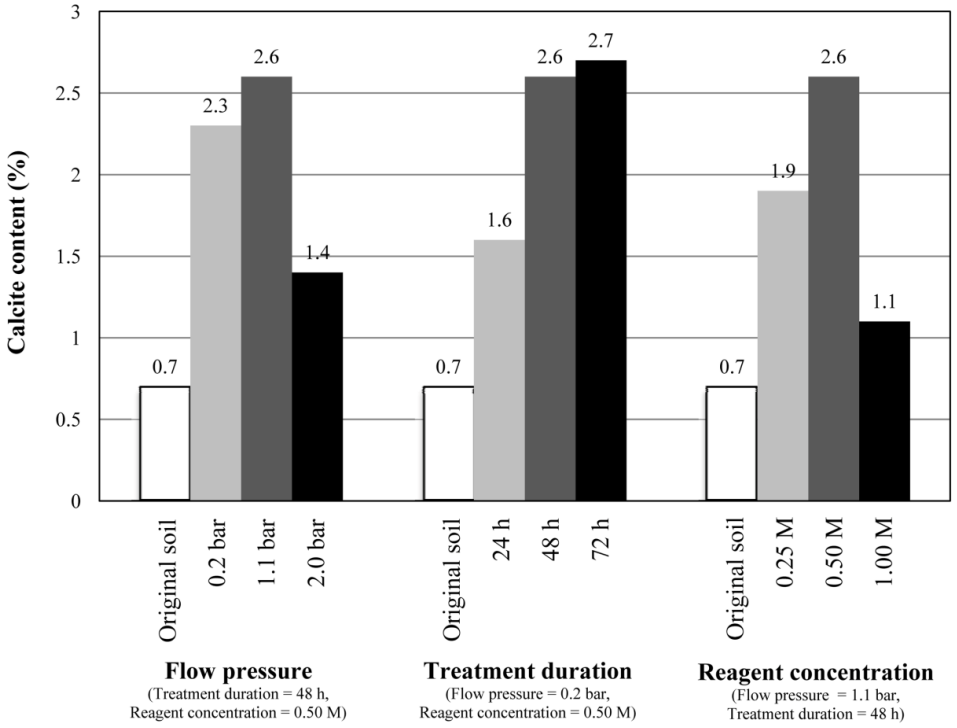

Fig. 4: Calcite contents of bio-mediated soils treated under various treatment conditions

POTENTIAL APPLICATIONS OF BIO-MEDIATED SOILS FOR SLOPE STABILIZATION

Based on the results of laboratory experiments above, it can be concluded that the preferable MICP treatment conditions for the residual soil are: 0.5 M cementation reagent , 1.1 bar flow pressure of reagent, and 48 hours treatment duration. The improvement in shear strength and reduction in saturated permeability obtained using this combination of parameters were 69 % and 90 %, respectively.

As mentioned earlier, studies on field applications of the bio-mediated soils are still very limited. In the present study, the potential application of the bio-mediated soil for slope stabilization was discussed. Rainfall has been identified as one of the most significant triggering factors for landslide occurrences in Malaysia. With the characteristics such as improved shear strength and reduced saturated permeability, the bio-mediated soil may function as an effective soil cover system for preventing the recurrent rainfall-induced landslides.

Shortcomings of the Existing Slope Cover System

One of the most widely researched cover systems for slope protection is known as capillary barrier. The system was developed based on the principle of unsaturated soil mechanics by using two soil layers (a fine-grained layer overlaying a coarse-grained layer) with distinctly different hydraulic properties. The effectiveness of the system has been investigated by numerous researchers (Stormont 1996; Morris & Stormont 1997; Khire et al. 2000; Tami et al. 2004; Rahardjo et al. 2007).

The existing capillary barrier systems, however, were subjected to two major shortcomings:

(i) Inability of the fine-grained layer to hold the infiltrated rainwater for a sufficiently long duration. The existing fine-grained layer is normally formed by fine sand or sandy silt because clay are susceptible to shrink and crack. However, sandy soils are typically characterized by weak water retention ability, which is not a favorable characteristic for forming the fine-grained layer. The rainwater may eventually breakthrough into the underlying soil under a prolonged rainfall.

(ii) Erosion and sliding failure may occur in the fine-grained layer as a result of excessive lateral seepage along the sloping soil interface. This will eventually impair the functionality of the entire system.

Advantages of using Bio-mediated Soil

Fig. 5 shows a proposed capillary barrier soil cover system using the bio-mediated soil. The use of bio-mediated soil as the fine-grained layer in the capillary barrier may offer several potential advantages:

(i) The water retention ability of the fine-grained layer can be significantly improved by bioclogging. The desired hydraulic properties of soil can be achieved by controlling the bio-activity / rate of MICP in the soil. This will minimize the potential of rainwater breakthrough into the underlying layer of capillary barrier.

(ii) The potentials of sliding failure and erosion in the fine-grained layer can be minimized by biocementation. Biocementation improves the shear strength and stiffness of soil through formation of calcite bonds. The stronger inter-particle bonds can provide better resistances against sliding failure and erosion.

(iii) The bio-mediated soil suits the requirements of 'green construction' as the MICP process exerts minimal pollutants to soils. It is a process that exists in nature as urease-producing microorganisms are found in abundance in natural soil and groundwater (Lloyd & Sheaffe, 1973; Fujita et al., 2000). There are no toxic or hazardous chemicals involved in the soil treatment process.

Feasibility of using the bio-mediated soil as the fine-grained layer in the existing capillary barrier system worth an insightful investigation. Future studies may look into unsaturated properties of the bio-mediated soil, matric suction variations of the improved capillary barrier system under prolonged rainfalls, and field performance of the capillary barrier system. Successful implementation of the system could effectively minimize the landslide hazards in Malaysia. It is also a more affordable solution compared to the construction of active mitigation measures such as retaining wall, soil nailing, and ground reinforcement etc.

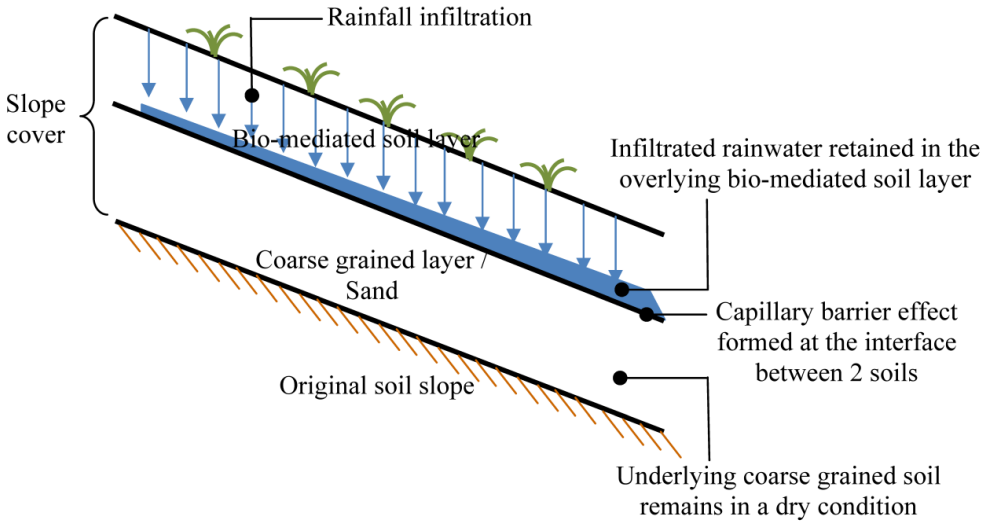

Fig. 5: Proposed bio-mediated soil cover system

CONCLUSION

This paper reports the results of laboratory experiments to investigate the preferable MICP treatment conditions for improving engineering properties of a typical tropical residual soil. The feasibility of using the bio-mediated soil for slope stabilization was also discussed. The following conclusions can be drawn from this study:

The preferable MICP treatment conditions for residual soil are: 0.5 M cementation reagent concentration, 1.1 bar flow pressure, and 48 hours treatment duration. The shear strength improvement and hydraulic conductivity reduction obtained from this combination of treatment parameters are 69 % and 90 %, respectively.

The shear strength improvement of bio-mediated soil possesses a different mechanism from the saturated permeability reduction. For shear strength improvement, the calcite are required to be precipitated at the particles contact points to form a strong calcite bonds. For saturated permeability reduction, no specific binding of soil particles are required for obstructing the water flow. The reduction in soil saturated permeability tends to be proportional with the amount of calcite precipitated.

The bio-mediated soil could be used for improving the performance of the existing capillary barrier system by increasing the water retention ability of the upper fine-grained layer, and minimizing the risks of sliding failure and erosion.

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Lee Min Lee
Assistant Professor
Faculty of Engineering and Science
Universiti Tunku Abdul Rahman
Kuala Lumpur, Malaysia 53300
Email: mllee@utar.edu.my
Telephone: +06 03 41079802
Fax no.: +06 03 41079803

6

Organizational Capabilities for Knowledge Sharing in Islamic Banking Malaysia

Abdusalam Abdulazez Abdulla Abuazoum,
Nurdiana Azizan & Nursilah Ahmad

ABSTRACT

Recent concerns about the issue of knowledge management (KM) within an organization have accentuated the need for more efficient and effective knowledge sharing (KS) that is (KS) plays an increasingly significant role in determining the outcomes of KM. Today, banks are beginning to understand the relevance and importance of knowledge management systems (KMS) and of KS. Similarly, banks are beginning to appreciate knowledge as the most significant and valued asset that leads to effective organizational performance. This research aims to investigate the role of certain factors in organizational culture for the success of KS. Factors such as interpersonal trust and communication among staff, information systems, rewards, and organizational structure play an important role in defining the relationships among staff, creating possibilities for breaking the obstacles to KS in the Islamic banking sector in Malaysia.

Key words: knowledge sharing, conventional bank, Islamic banks

INTRODUCTION

The well-known knowledge era has radically changed the values in organizations (Carlisle, 2001). Since the emergence of this era, the long-term viability and prosperity of organizations has been viewed as being increasingly dependent on the ability of organizations to leverage the concealed worth of this crucial, acquired, intangible knowledge. In previous years, the commodities of the capital and labor-intensive firms were gradually replaced owing to continuous change in market expectations and increased demand for new products introduced by knowledge-intensive firms, (Ali & Ahmad, 2006). Knowledge sharing (KS) is undoubtedly an important component in all organizations, especially in banking institutions that pursue knowledge as an intangible and highly sought asset. KS is important in distinguishing the competitive and rapidly changing environment, as it enables not only intellectual reuse but also the renewal of knowledge possessed by bank employees. Therefore, Barachini, (2009), emphasized that these organizations must continuously motivate their employees to share valuable information to leverage their intellectual capital. This study aims to examine the KS strategies that help increase the tendencies of employees in Islamic banks in Malaysia to engage in KS practices.

Background of Study

The importance of research comes from that of the research variables in contemporary organizations and societies. This importance is likewise revealed through the ways by which organizations could be provided with information and communication technology to expand the possibilities of KS, which could not have been achieved previously, as well as to provide real opportunities for KS to contribute to their strategic development. This study provides significant influence and impact in determining the success of the sharing of warranted knowledge among employees of Islamic banks to achieve organizational competitiveness. The research findings provide useful information and deepen the understanding of Islamic banks in motivating their employees to engage in KS practices.

Scope of Study

This paper aims to assess the level of KS among the staff and managers of a number of Islamic banks in Malaysia. Through questionnaires and interviews, we evaluate the exchange of experiences and knowledge based on documents and all elements of knowledge, to identify the factors hindering KS in Islamic banks. The results of our survey are analyzed using SPSS software.

Problem Statement

Malaysia has differentiated itself from other Islamic countries, as its government has implemented a parallel system wherein Islamic and conventional banks function alongside each another, as opposed to full Islamisation (UKM. April 2004). Insufficient personnel training is one of the issues in this study (Kahf, 1999). Many Islamic banks recruit their employees from conventional banks, and these employees sometimes experience difficulties in understanding Shari'ah rulings. Conventional banks that implement a parallel system (Islamic banks) allow institutions to offer Islamic banking products and services using their existing infrastructure, including staff and branches (Khurrum, 2006).The issue is whether to hire non-Muslim staff or staffs who possess no information or knowledge on Shari'ah.

As a result of the lack of independence of conventional Islamic banks, independent Islamic banks have become industry leaders, particularly because their employees are ready to share Islamic information. This result therefore reflects the problem on the growth and development of Islamic banking in Islamic banks as well as on the correct non-application of religious texts. The problem of the ineffective dissemination of existing knowledge throughout the organization was addressed.

Objective

The objective is to compare KS Islamic activities through ICT between Islamic banks and conventional banks that use a parallel system wherein the Islamic and conventional systems function alongside each other.

Literature Review

Islamic banking

"Islamic banking has become a substantial and fastest growing industry during the last four decades. It has followed the Islamic transactions rules and principles (Shari'ah) to carry out

their business" (Henry & Wilson, 2004), (Iqbal & Mirakhor, 2007), (Dusuki & Abdullah, 2007). According to Shari'ah principles, any payment or receipt of interest is strictly prohibited, although the Islamic bank offers products and services that are more or less similar to those offered by a conventional bank.

Conventional banks which added service Islamic banking to its system banking

Malaysia differs from other Islamic countries in that its government has implemented a parallel system wherein Islamic and conventional banking can function alongside each another, rather than adopting full Islamisation. This implementation is the first step of the country towards the development of a dual system where Islamic banking and the conventional system function parallel to each other (Khurrum, 2006).

Islamic banks

Malaysia, as one of the first countries to introduce Islamic banking, is deeply committed to developing a complete Islamic financial system. The Malaysian government established the first Islamic bank in the beginning of the 1980s, and followed by the Bank Muamalat. These Islamic banks have been independent since their inception, (Haron & Wan Azmi, 2005).

Theoretical Framework of This Study

Organizational knowledge capability

The core capabilities of a knowledge organization are important in providing information and knowledge-based services. (Yang & Chen, 2007). Wiig (1994) claims that KM initiatives would fail if the investments of organizational resources and capabilities are inappropriate. In other words, effective KM should contribute to organizational performance through the development of organizational knowledge capability (Malhotra& Segars 2001). Empirical studies (Yang & Chen,

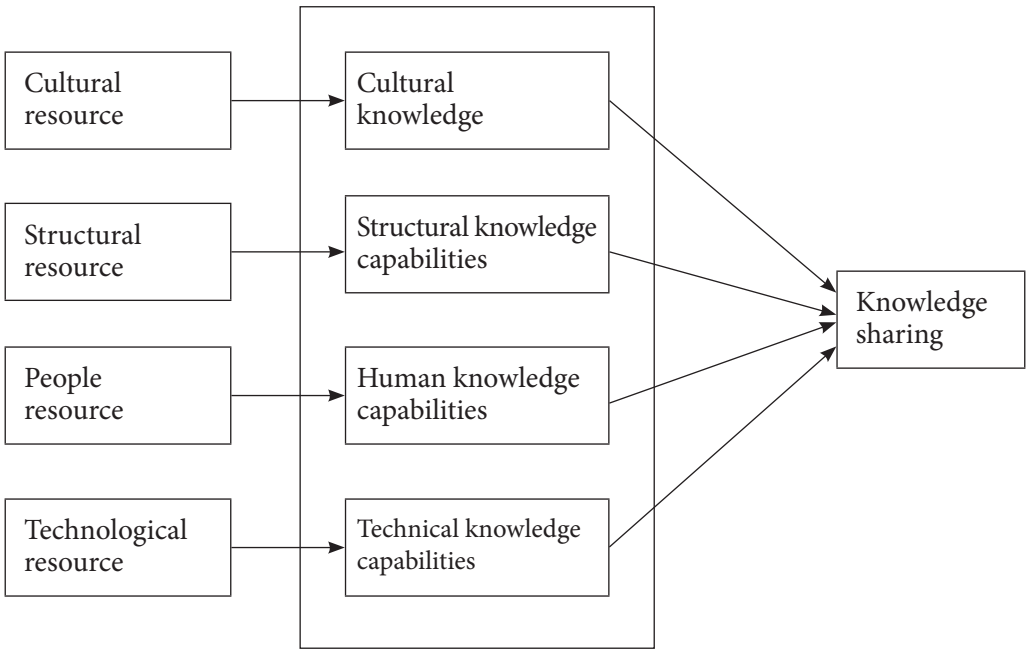

Figure 1: A framework linking organizational knowledge capabilities to knowledge sharing. Source: (Yang & Chen, 2007).

2007), reveal that the organizational capability to learn or acquire the required knowledge from other organizations is a key resource for successful KS. Thus, the enhancement of knowledge capabilities as the foundation of organizational development is beneficial for organizational effectiveness. Normally, organizations invest on process improvement, work effectiveness, learning, and supporting technology that facilitate knowledge (Lee's 2001).

Research Methodology

Connect the data

In connecting the two data types, the researchers realized the need for further data collection to support results after analyzing the first set of data. Therefore, following the results of the initial phase, the second phase of data collection is marginal and supportive, intended to explain the initial results, (Cresswell & Plano Clark, 2007).

Design of research process

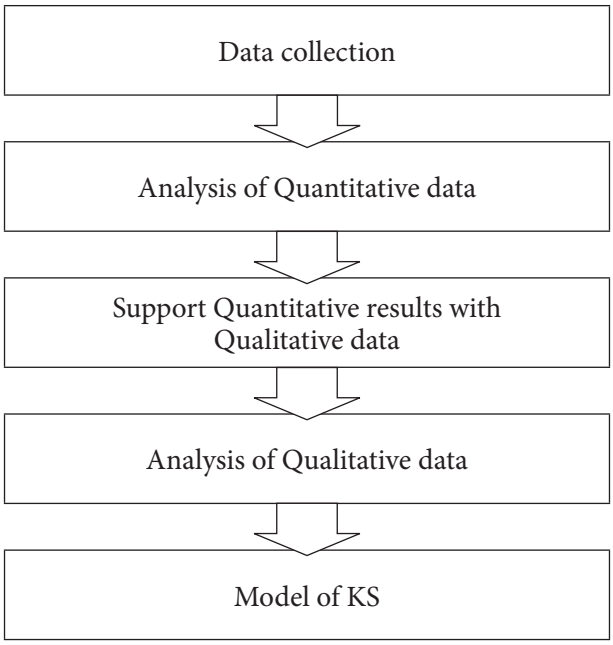

Figure 2: connecting the data mixed method

Research Questions

The research question for this paper is:
How can one understand the source of any observed differences in the KS Islamic activities using ICT among Islamic banks and Islamic banks adopting a parallel system?

Expected Output

1. There is a positive relationship between trust and attitude and behavior among coworkers and knowledge sharing in organizations.
2. Reward system and learning has a positive and significant impact on knowledge sharing

3. Intellectual capital and social interactions for staff have a positive effect on the knowledge sharing behavior within an organization.
4. IT and IS infrastructure has a positive and significant impact on knowledge sharing.

Contribution

Islamic banking is a growing sector in Malaysia and many other countries. KS among staff is important in improving the performance and ensuring the sustainable growth of Islamic banks. The potential for KS in developing countries is reportedly higher than that in other parts of the world (Voelpel & Han, 2005). Banking institutions that intend to fully leverage their knowledge potential must first appreciate and look forward to the enablers that affect KS as a whole. Therefore, this study eventually expects to facilitate and assist the banking sector in improving its recognition and understanding of factors that further induce KS in Islamic banks and in conventional banks with Islamic banking services. Moreover, the study aims to determine the status of Islamic information sharing among staff and the success of KS in Islamic banks. The issue is whether to hire non-Muslim staff or staff with no information or knowledge about Shari'ah, as such employees could create problems for customers of Islamic banking services and on the correct application of religious texts. Islamic banks should overcome such issues and gain a deeper understanding of its staff needs and demands to support KS among them. New staff should be trained in KS, creating a better understanding of the correct application of religious texts and provision of Islamic banking services.

CONCLUSION

This study examines the KS problem and its effects on the KS process, in the context of Islamic banks in Malaysia. Islamic banking institutions must first appreciate and look forward to the enablers and barriers that affect KS as a whole to fully leverage their knowledge potential. Therefore, this study is expected to facilitate and assist the Islamic banking sector in improving its recognition and understanding of KS among staff in Islamic banks in Malaysia.

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Abdusalam Abdulazez Abdulla Abuazoum
Mukm2012@Yahoo.com

Nurdiana Binti Azizan
Faculty of Science And Technology
Nurdiana@Usim.edu.my

Nursilah Binti Ahmad
Faculty of Economics And Muamalat,
Universiti Sains Islam Malaysia
Nursilah@Usim.edu.my

7

Loss Measurement 1000kVA 3Phase Transformer Core Assembled with Amorphous Ribbon Core Material

Dina Maizana & Emi Zurima Bt Ismail

ABSTRACT

This paper describes the result of measurement of core loss in 3 phase 1000kVA distribution transformer build of amorphous ribbon. Arrangement of core building that used in this investigation is zigzag term. The investigation involves the variation of power loss, 3rd 5th and 7th harmonic of flux and the total harmonic distortion of flux. The power loss and flux distribution have been measured using no load test. The power loss of the transformer core assembled amorphous ribbon of 6.4378 W/kg at flux density of 1.0T, 50 Hz. With the high harmonic will produce the high losses. A depression and overlapping of lamination sheet is highest cause of harmonic content in core building.

Keywords: Transformer core, power loss, Amorphous Ribbon and flux distribution.

ABSTRAK

Kertas kerja ini menerangkan hasil daripada pengukuran kehilangan teras dalam 3 fasa 1000kVA pengubah agihan yang dibina dari reben Amorfus. Susunan binaan teras yang digunakan dalam penyiasatan ini adalah bentuk siku-sika. Siasatan itu melibatkan perubahan kehilangan kuasa, 3, 5 dan 7 harmonik fluks dan jumlah herotan harmonik fluks. Kehilangan kuasa dan pengagihan fluks telah diukur menggunakan ujian tampa beban. Kehilangan kuasa teras pengubah yang dipasang reben Amorfus daripada 6.4378 W / kg pada ketumpatan fluks 1.0T, 50 Hz. Dengan harmonik tinggi akan menghasilkan kerugian yang tinggi. Lekukan dan pertindihan lembaran laminasi adalah punca tertinggi kandungan harmonik dalam binaan teras.

Keywords: Teras pengubah, kehilangan kuasa, amorfus reben dan agihan fluks.

INTRODUCTION

The study of amorphous material as transformer core lamination is not finish yet until now by many researchers with purposes to find the minimum losses on electrical system. The amorphous ribbon arrangement in transformer building that have been used is in conventional and step lap arrangement. The study has been done by using experiment and simulation method. Which is the step lap core arrangement has lower loss than the conventional arrangement. [1-5] Meanwhile, the amorphous core material has the saturation induction achieves 1.64T and lower compare the silicon iron material. [6]

The objective of this investigation is to measure the power loss of the transformer core built of the amorphous ribbon assembled with zigzag core arrangement.

EXPERIMENTAL APPARATUS AND MEASURING TECHNIQUES

A three phase with 3 limb wound core is assembled with zigzag core arrangement is shown in Figure 1. The inner core dimensions are 480 mm x 270 mm with the limb of 140 mm wide. The core is assembled using 45 µm thick of laminations of amorphous ribbon and has stagger yoke of core with overlap length of 5 mm from other adjacent lamination when setting the transformer core lamination as shown in Figure 2. The transformer core comprises of 38 layers.

The testing process is done by using the No-Load test as indicated in Fig. 3. The three phase transformer has power rating 1000kVA with weight of 2.47 kg which is need three phase input from three phase power supply (0 – 450V) with less than 1.5% third harmonic distortion as the input voltage will be used as primary input. The ratio of this transformer is 1:1. The output from secondary of three phase transformer will be connected to the power analyzer with repeatability better than ± 1% in order to measure voltage, power loss and harmonic. The core could be energized 0.4 T to 1.5 T with less than 1.5% third harmonic distortion and the power loss is measured with repeatability better than ± 1% using a three phase power analyzer. The transformer model is shown in Figure 4.

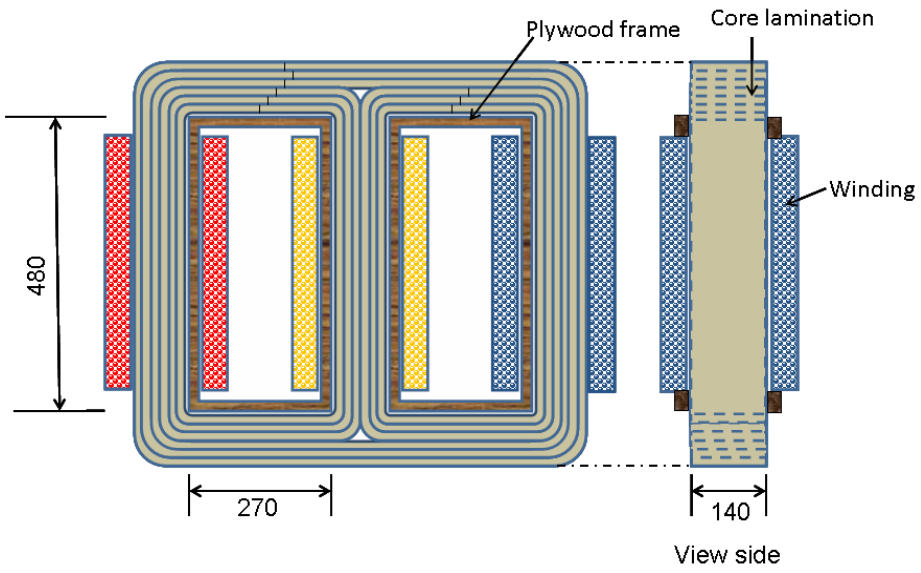

Figure 1: Dimension (mm) of 1000 kVA 3 phase transformer core model

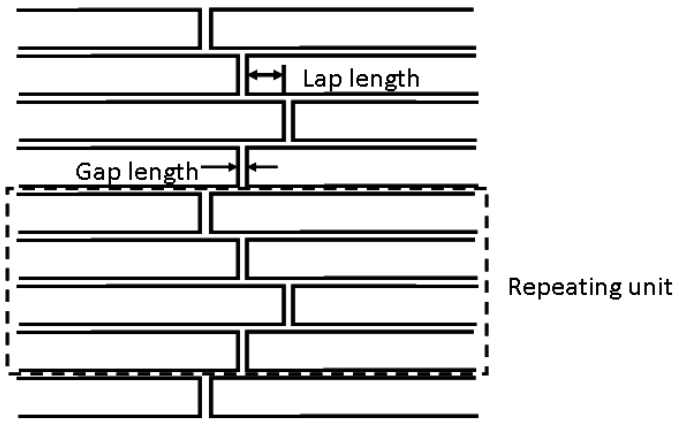

Figure 2: Zigzags arrangement of core laminate

To calculate the phase voltage is using the Equation 1 and writes down in Table 1. After that, arrange all winding in the transformer core and connection wire as shown in Figure 4.
To calculate actual line voltage is

$$V = 4.44 \text{ x } B \text{ x } N \text{ x } f \text{ x } A \text{ x } s_f \quad (1)$$

where V is a voltage,
4.44 is a constant value,
B is flux density and the unit is Tesla,
N is number of turn winding and N=154,
f is frequency with standard value 50 Hz,
A is core area and the value is 19 layers x 2 x 14cm x 45 μm,
s_f is stacking factor with constant value equal to 0.96.

Table 1: The Actual Line Voltage for primary winding of transformer assembles with star connection

No	Flux Density, [T]	Line Voltage [V]
1	0.4	5.4
2	0.5	6.75
3	0.6	8.1
4	0.7	9.45
5	0.8	10.8
6	0.9	12.15
7	1.0	13.5
8	1.1	14.85
9	1.2	16.2
10	1.3	17.55
11	1.4	18.9
12	1.5	20.25

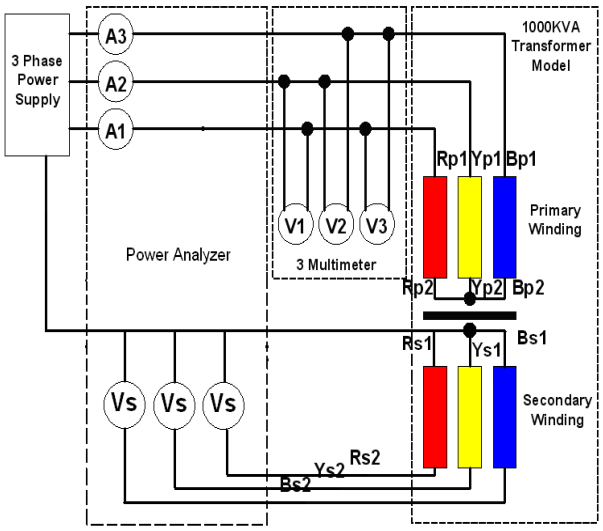

Figure 3: Test Circuit for Overall Power Loss measurement

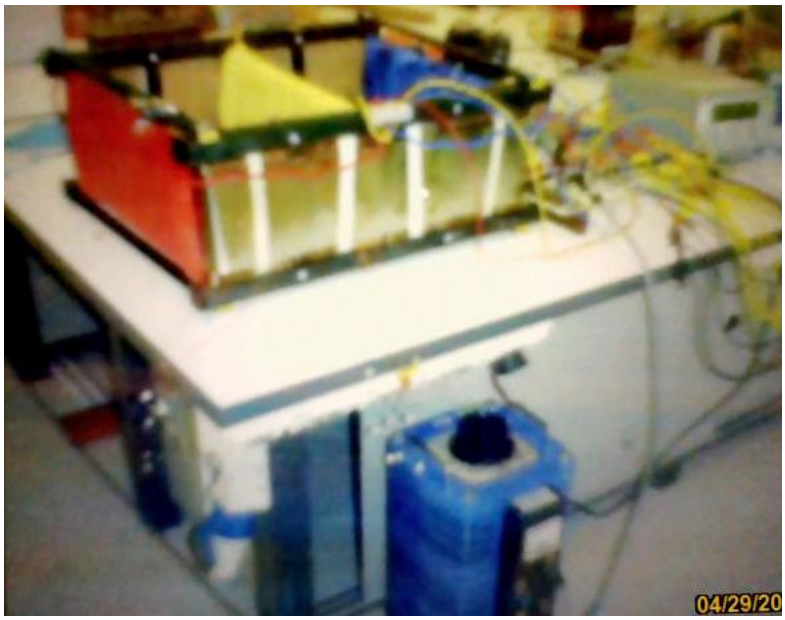

Figure 4: Actual transformer core model

EXPERIMENTAL RESULT

Figure 5 shows the variation of overall power loss with flux density in the three phase cores of core lamination of transformer core. The power loss of the transformer core assembled with amorphous ribbon of 6.4378 W/kg at flux density of 1.0T, 50 Hz.

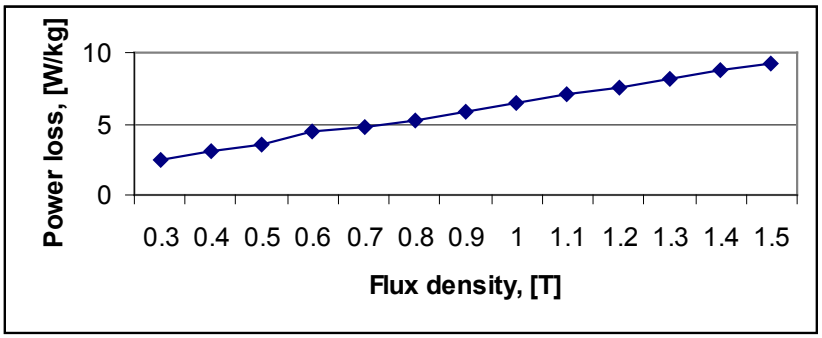

Figure 5: Graph Power Loss from measurement of core lamination of transformer core

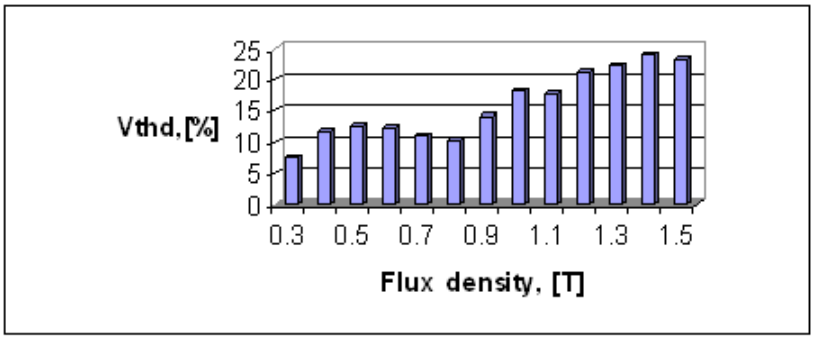

Figure 6: Total harmonic distortion of flux from measurement for transformer core model

The total harmonic distortion (THD) of flux will be increased, over the whole flux density range as shown in Figure 6. The seventh harmonic content is not influence the total harmonic content because the percentages of seventh harmonic is too small than the third and fifth harmonic content of flux as shown in Figure 7.

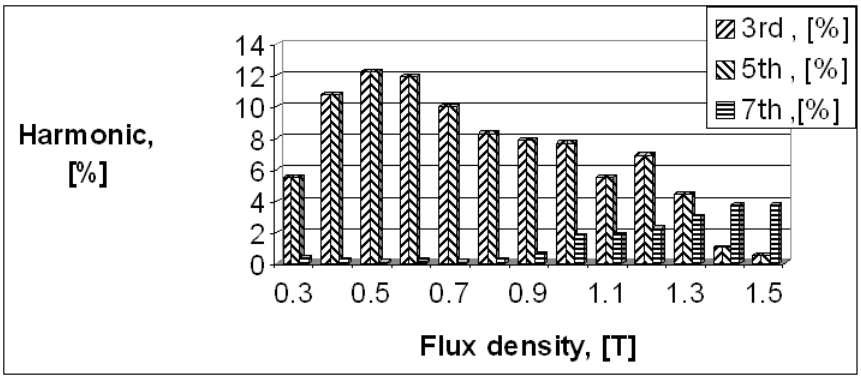

Figure 7: Harmonic of flux for transformer core

DISCUSSION

The loss of transformer is influence by the harmonic effect as presented from the experiment result. The important factor that influence of harmonic of this investigation such as core arrangement and the butt joint of core lamination.

Flux flowing through the laminate sheet will move in the normal direction to adjacent sheet is up and down. Apart from the flux will also move in the direction of in-plane wearing flux will be moved to the following laminate sheet at the butt joint. Flux and flow around the core will continue. This is described in Figure 8.

When a recessed portion lamination sheet when the layout on the laminate sample frame number 2 as shown in Figure 9, in this area there will be change in the flux through the laminate sheet. Flux will generate high harmonic flux when moving in the normal direction to the sheet toward nearby and so is the in-plane direction. When the high of harmonic, it will be cause the high of losses.

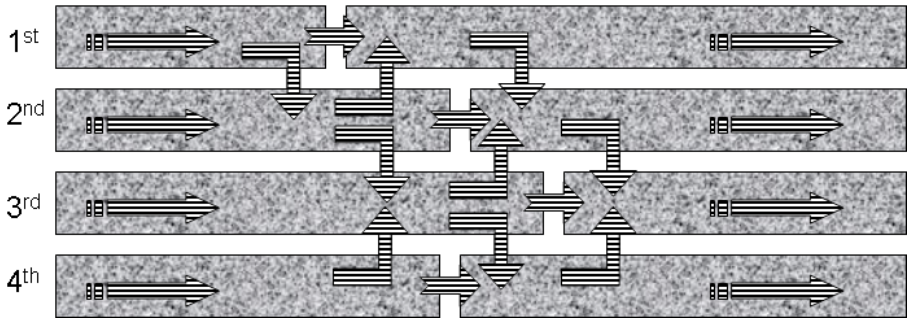

Figure 8: Flux flow in one cluster of core lamination

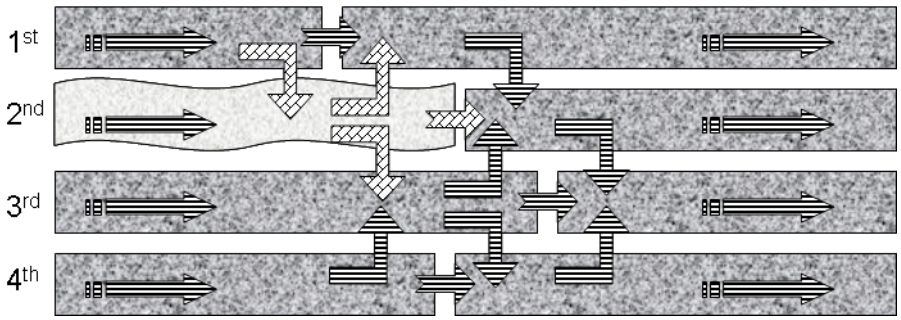

Figure 9: A recessed portion Lamination sheet

When laminated sheet overlap occurs in transformer core building as shown in the laminate number 3 see Figure 10. There would be differences in the normal flux transfer area or in-plane. It will produce a high harmonic in the area and cause the high losses.

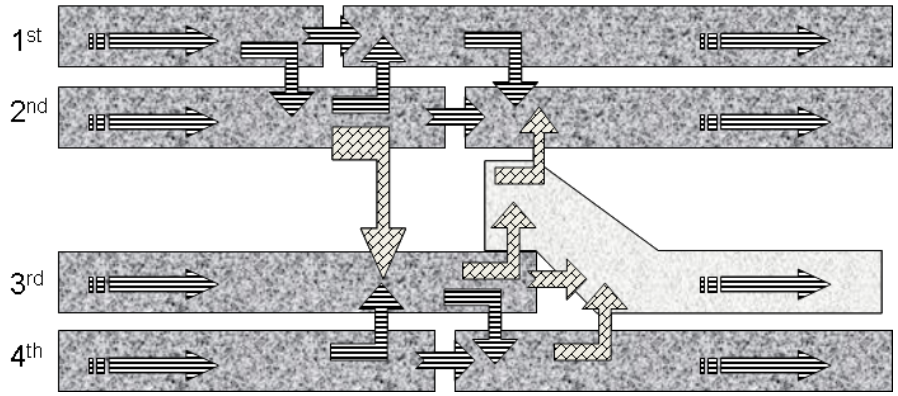

Figure 10: Laminated sheet overlap

CONCLUSION

From these findings, it is clear that if the core is build with amorphous ribbon to note is how to organize the laminate. When depression occurs in one part of the laminate or laminate overlap between the two ends of the connection so in this area will appear high harmonic. It will cause high losses in the core as a whole.

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Dina Maizana
School of Electrical System Engineering
Universiti Malaysia Perlis (UniMAP),
P.O Box 77, d/a Pejabat Pos Besar
01007 Kangar Perlis, Malaysia
Email: dina @unimap.edu.my
Contact number: +6016-4363589

Emi Zurima Bt Ismail
School of Electrical System Engineering
Universiti Malaysia Perlis (UniMAP),
P.O Box 77, d/a Pejabat Pos Besar
01007 Kangar Perlis, Malaysia
Email: ezurima@gmail.com
Contact number: +6017-4823648

8

Flood Prediction Modelling Using BPN and Elman Neural Network: A Comparative Study

Fazlina Ahmat Ruslan, Ramli Adnan, Abd Manan Samad & Zainazlan Md Zain

ABSTRACT

Recently, the artificial neural network have been successfully applied to various hydrologic problems. This paper proposed flood water level modelling using Back Propagation and Elman structure neural network that using the water level data from Sungai Kelang which is located at Jambatan Petaling, Kuala Lumpur. The models were developed by processing offline data over time using neural network architecture. The methodologies and techniques of the two models were presented in this paper and comparison of the long term runoff time prediction results between them were also conducted. The prediction results of the Elman neural network architecture indicate satisfactory performance for the three hours ahead of time prediction. The performance indices results also concluded that the Elman neural network model was more reliable than that of the Back Propagation neural network model and can be considered as an alternative a and practical model for predicting long term flood flow.

Keywords: Back Propagation Neural Network (BPN); Elman Neural Network (ENN)

ABSTRAK

Baru-baru ini, rangkaian neural tiruan telah berjaya diapplikasikan dalam penyelesaian pelbagai masalah dalam hidrologi. Kertas-kerja ini mencadangkan pemodelan paras air banjir menggunakan struktur rangkaian tiruan Perambatan Kembali (BPN) dan struktur Elman yang menggunakan data paras air dari Sungai Kelang di Jambatan Petaling, Kuala Lumpur. Model kajian dihasilkan dari pemprosesan data ke atas masa di luar talian dengan menggunakan senibina rangkaian neural. Kaedah dan teknik untuk menghasilkan kedua-dua model tersebut dinyatakan dalam kertas-kerja ini dan perbandingan keputusan ramalan masa aliran jangka panjang juga diberikan. Keputusan ramalan dari senibina rangkaian neural Elman menunjukkan pencapaian yang memuaskan untuk masa ramalan tiga jam ke hadapan. Keputusan indeks pencapaian juga merumuskan bahawa model rangkaian neural Elman adalah boleh diharapkan berbanding model dari rangkaian neural Perambatan Kembali. Dengan itu rangkaian model Elman boleh dipertimbangkan sebagai model alternative dan praktikal dalam meramal aliran banjir jangka panjang.

Kata-Kunci: Rangkaian Neural Perambatan Kembali; Rangkaian Neural Elman

INTRODUCTION

Flood water level prediction system is very important to densely populated areas located downstream of the rivers. Without a doubt, flood flows at downstream areas are strongly influenced by upstream water conditions. Thus, flood water level prediction system is very important to help the resident of downstream areas to evacuate prior to flood occurrence.

Flood modelling using the artificial neural network (ANN) model is best suited for the above mentioned problem. ANN is widely known as an effective approach for handling large amount of dynamic, non-linear and noisy data especially in situation where the underlying physical relationships are not fully understood. The ANN model also has various mathematical compositions capable in modelling extremely complex physical systems. For this reason, ANN has been successfully applied to various problems in water resources field whereby most cases deals with nonlinear data. ANN has been applied in rainfall runoff models [1-3], stream flow forecasting [4, 5], reservoir inflow prediction [6, 7] , mean sea-level height estimation [8] and etc.

Most ANN models used in water resources field were multi-layer feed-forward neural networks trained using the BPN algorithm. Dawson et al. [9] applied BPN model to predict flood events and providing flood index (the median of the annual maximum series) for 850 catchments across UK. When compared with multiple regression models, BPN provides improved flood estimation that can be used by engineers and hydrologists. Simulation of water levels at different section of a river using physical flood models is quite cumbersome because it requires many types of data such as hydrologic time series, river geometry and etc. Therefore ANN technique was used as an effective alternative in hydrologic simulation studies. Simulation results using feed-forward neural network architecture with Levenberg Marquardt BPN training algorithm were compared with MIKE 11 hydrodynamic models to predict river stage for the periods of June until September 2006 [10]. The results obtained from the BPN model were found to be much better than that of the MIKE 11 results as indicated by the values of the goodness fit indices used in the study.

Most references in flood forecasting [11-13] emphasize on how to obtain a deterministic BPN model to achieve an accurate model. Aspects such as structural modification, the determination of the type and number of input variables or hidden variables and the learning data length are very critical factor in determining an accurate BPN model. When applying a deterministic BPN model, the input and output relationship also should be systematic because the learning process of BPN algorithm is a supervised learning. Supervised learning means the model adjust the parameters (weights and biases) according to the "generalized delta rule" to minimize the error between the targets output and the estimated outputs of the BPN model [14-16]. The parameters adjustment stop when the learning criteria are fulfilled and then the optimal value of the parameters are adopted prior designing a deterministic BPN model.

Nevertheless, the application of ENN in water resources field is quite new among researchers. It can be seen from the small numbers of literatures and work done on ENN model for hydrologic applications. In [17] Wu proposed ENN structure to be applied to groundwater level prediction of Naoli River basin. It can be seen that the model has high prediction

accuracy and faster convergence time with regards to prediction result. Comparative study on Jordan and Elman neural network model for short term flood forecasting was done by Deshmukh et al [18]. Both models were developed for rainfall modelling at the upstream area of Wardha River in India. The prediction results using Jordan neural network shows good performance in the three hours ahead of time prediction. They also find out that the Jordan neural network model is more robust than Elman neural network model and can be used as an alternative tool for short term flood flow prediction.

This paper was organized in the following manner: Section II describes the methodology; Section III is on results and discussion; and finally, Section IV is on conclusions.

METHODOLOGY

Back Propagation Neural Network (BPN)

The BPN model is an extensively used neural network that comprises of many processing units/nodes or widely known as neurons. In general, BPN model consists of three layers structure of neurons as in Figure 1. The input layer receives input signals from the external worlds. The hidden layer represents the relationship between input and output layer and finally, the output layer releases the output signals to the external world. It includes training and validation process. The aim of the model training is to perform input and output mapping based on the determined BPN model structure to obtain the optimal weight of neurons in the hidden layer. In addition, there are factors that leads to the optimal weight which are the size of the training data and how it represents the environment of interest, the structure of the BPN model and the physical complexity of which the model is applied [19]. Despite that three factors mentioned above, optimal BPN model structure could be obtained by trial and error method [20].

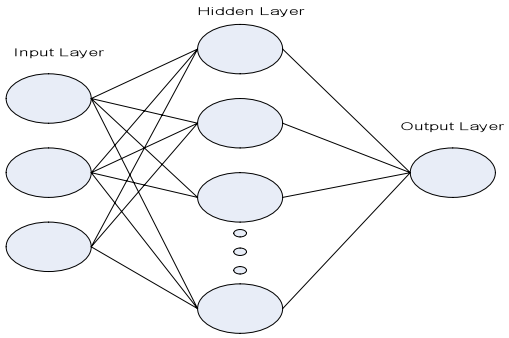

Figure 1: Typical ANN model structure

Elman Neural Network (ENN)

The Elman Neural Network (ENN) model structure was first proposed by Elman J.L. in 1990 [21, 22]. ENN has been developed for nonlinear modelling and transfer function cases such

as nonlinear stable adaptive control [23], solar activity forecasting [24] and much more. The ENN is one type of recurrent network. The details of ENN can be referred in [25]. The block diagram of ENN structure is shown in Figure 2.

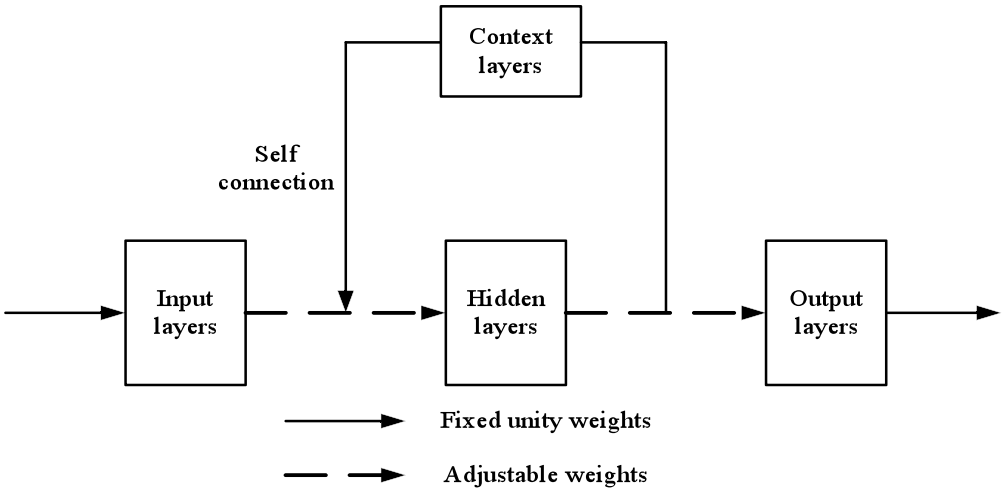

Figure 2: Block diagram of Elman Neural Network

ENN structure has one additional layers compared to BPN model structure which is named as context layers. In ENN structure, the hidden layers are feed-backed through this context layer. The feedback makes ENN able to learn, recognize and generate temporal patterns as well as spatial pattern. Every hidden layer neuron is connected to only one context layer neuron through a constant weight. Hence, the context layer virtually constitutes a copy of state of the hidden layer one instant before. The number of context layer neurons is consequently the same as the number of hidden layer neurons. Alternatively, every neuron of the output layer can be connected to only one neuron of a second context layer through a constant weight, as well.

Study area and data used in BPN model

The flood location in this study is Sungai Kelang at Jambatan Petaling, Kuala Lumpur. The major contribution of flood water level comes from three upstream rivers, Sungai Kelang at Jambatan Sulaiman, Sungai Kelang at Jambatan Tun Perak and Sungai Gombak at Jalan Parlimen is used in BPN model with additional input of rainfall at the flood location. The water level and rainfall data for training is in meters, starting from 18/11/2010 at 0:10:00 am until 22/11/2010 at 0:10:00 am in 10 minutes time interval. The target flood location data is in 3 hours ahead from the training data, meaning that the data is starting from 18/11/2010 at 3:10:00 am until 22/11/2010 at 3:10:00 am in 10 minutes time interval. For testing, the data range is from 6/3/2011 at 0:10:00 am until 11/3/2011 at 0:10:00 with same time interval. This real-time data is available online from the website www.water.gov.my. The water level data is measured using Supervisory Control and Data Acquisition System (SCADA) by Department of Irrigation and Drainage Malaysia.

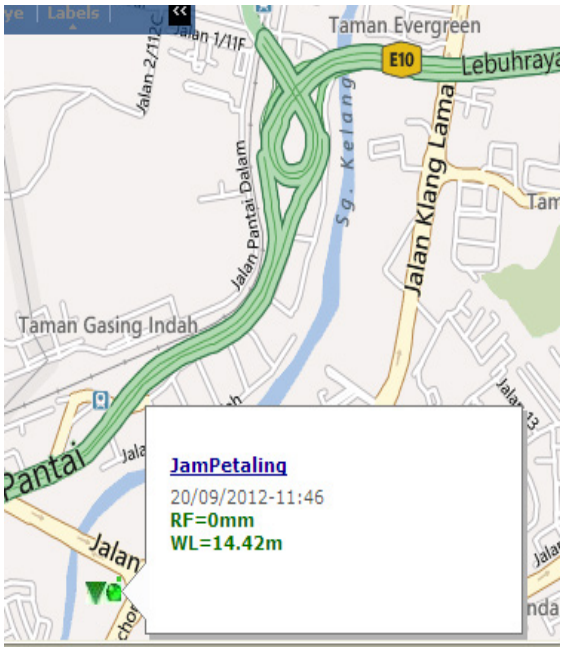

Figure 3: Location of Sungai Kelang at Jambatan Petaling basin (http://infobanjir.water.gov.my/ve/vmapkl.cfm)

Performance Indices

The performance of BPN model is evaluated using available statistical method to compare the result of simulated and actual data. These statistical methods can be expressed as follows:

(i) Akaike's Final Prediction Error(FPE);

$$\text{FPE} = V.\frac{\left(1 + d/N\right)}{\left(1 - d/N\right)} \tag{1}$$

where;
V = Loss Function
d = Number of approximated parameter
N = Number of sample

(ii) Loss Function(L);

$$V = \frac{e^2(k)}{N} \tag{2}$$

where;

$e^2(k)$ = error vector

(iii) Root Mean Square Error(RMSE);

$$\text{RMSE}=\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(Q_i-\hat{Q}_i\right)^2} \tag{3}$$

where;
Q_i = actual data
$\hat{Q}_i$ = simulated/predicted data

RESULTS AND DISCUSSION

BPN prediction results

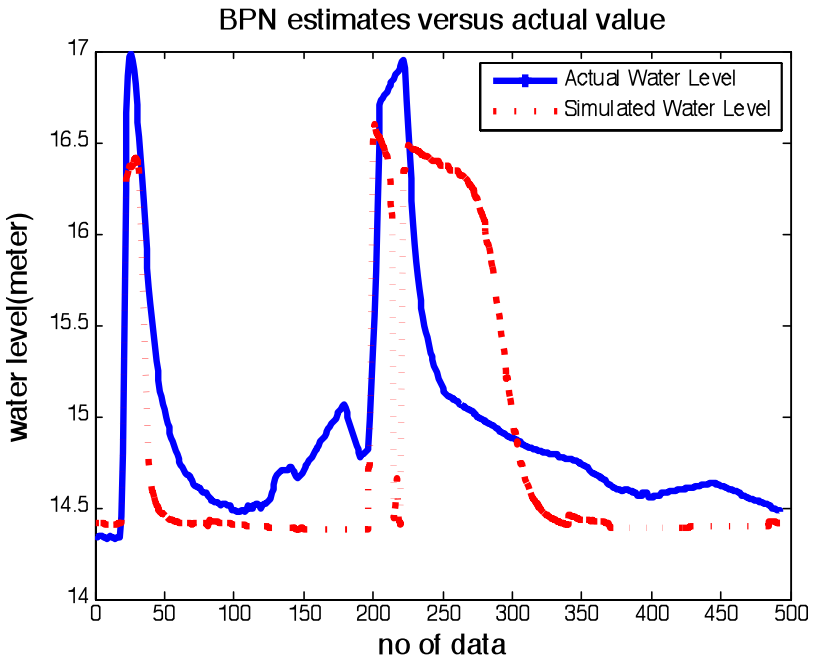

Figure 4: Simulation result of BPN model

In this study, two types of neural network models were constructed and tested for predicting flood water level at Sungai Kelang that located at Jambatan Petaling, Kuala Lumpur (BPN and ENN). The optimal number of parameters for both models was determined by trial and error method. Various hidden layer neuron number combinations were tested for the BPN model. A feed-forward 4-10-1 neural network was constructed and trained using the Gradient Descent (GD) algorithm with tangent sigmoid as transfer function in the hidden and output layers. The predicted result of the BPN model is given in Figure 4 after 10000 epochs. It can be observed that the BPN model's performance has a good tracking result at the earlier stage of simulation even though it still underestimate the actual water level result. However, towards the end, the BPN model is trying to follow the actual water level to produce good prediction results. This is

due to lacking in the number of input parameters in the BPN model. In this BPN model, only 2 input parameters were considered namely, water level data and rainfall data. This is due to that only both input data were available from the Department of Irrigation and Drainage, Malaysia. Others input parameters such as basin information and physical parameters are difficult to obtain as it involves the confidentiality of data from the department involved. Other reason that leads to poor prediction in this BPN model is the effects of nonlinearity of the data itself. In addition, Figure 5 provides the error convergence graph from this BPN model. Even though the error goal is not converged, the result was fairly good because the RMSE is equal to 0.7256m which is still less than 1.

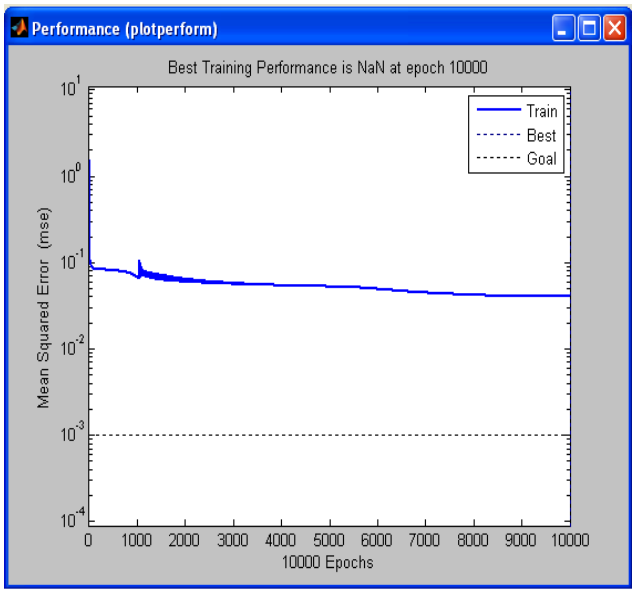

Figure 5: Error convergence result of BPN model

ENN prediction results

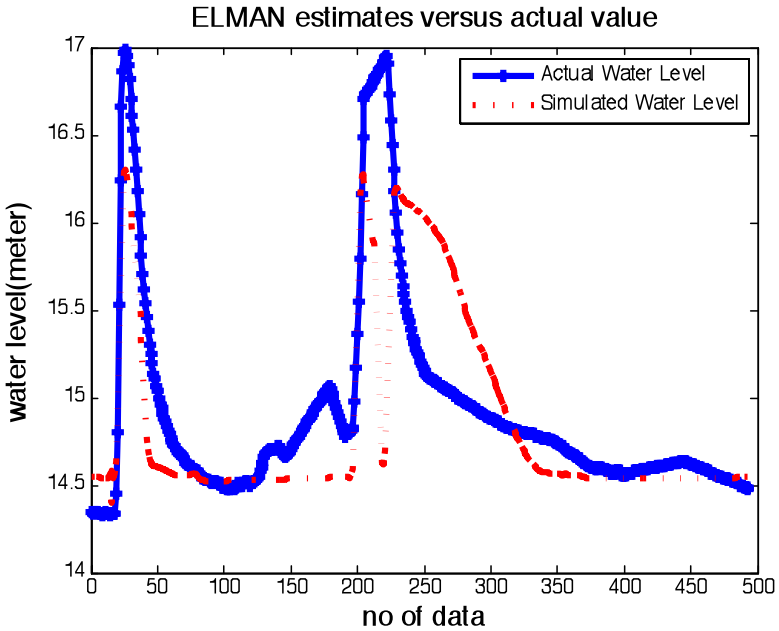

Figure 6: Simulation result of ENN model

Various numbers of hidden layer neuron combinations were tested for the Elman model. The 4-15-1 Elman network was constructed and trained using the gradient descent algorithm with default value of learning rate and momentum constant, 10000 epoch and tangent sigmoid transfer functions in the hidden and output layer. The size of training and validation data was already determined as 493 data points. The prediction results of ENN model produced by GD algorithm are shown in Figure 6. The ENN model showed better result than BPN models in terms of the performance indices value given in Table I despite the prediction result of ENN model is nearly the same in trend pattern with BPN model. At the earlier stage of simulation, the ENN model is able to follow the actual water level convincingly whereas, towards the peak value of flood water level, the model fail to predict the actual data anymore. This is due to the underestimate scatter plot of prediction results that occurred at the peak flood water level stage. Figure 7 displays error convergence results of ENN model with RMSE equal to 0.5931m. Even though the error is not converged, the error measured value still close to zero to justify that the ENN model is an acceptable model in this flood water level prediction. Comparison of measured error values for both models is given in Table I. From the table, it can be observed that there are significant drops in error from the ENN model. This shows that ENN model provides better performance than the BPN model in predicting flood water level.

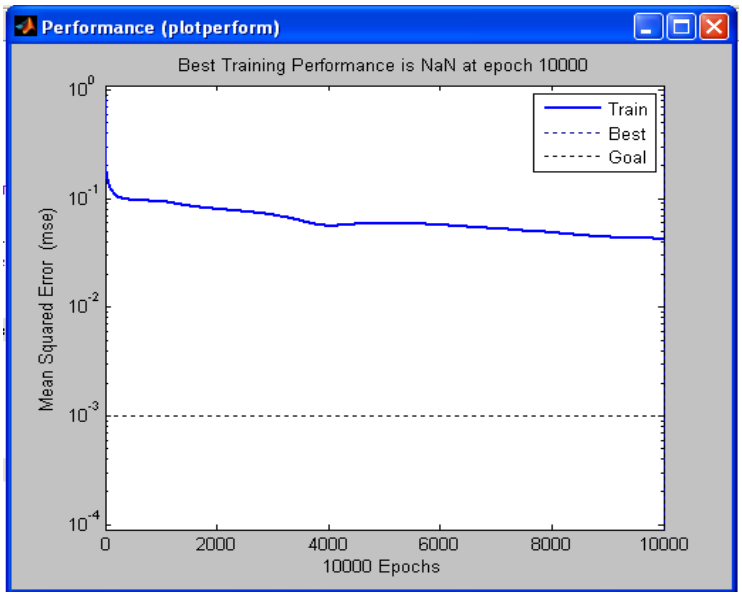

Figure 7: Error convergence result of ENN model

Table I: Performance Indices Result

Performance Indices	BPN Model	ENN Model
Akaike's Final Prediction Error (FPE)	0.1993m	0.1349m
Loss Function (V)	0.1977m	0.1338m
Root Mean Square Error (RMSE)	0.7256m	0.5931m

CONCLUSIONS

This study describes an approach to estimate flood water level from meteorological data sets obtained from the Department of Irrigation and Drainage, Malaysia with two nonlinear modelling techniques. In this study, two relevant variables were used for estimating the flood water level namely, water level and rainfall data. The construction of nonlinear modelling structures using the BPN and ENN models have been demonstrated. Both models performances were compared in terms of their tracking errors. The performance of Elman model was determined to be better than that of the Back Propagation model. The resulting errors for BPN model still providing high degree of accuracy with error less than 1 and merely close to 0. Despite the widespread application of neural network models for nonlinear cases, comparative studies using different models were lacking. Most published research work so far only using a limited number of nonlinear models. Thus, these comparative studies in using different nonlinear models for flood water level prediction would be a valuable source of information to researchers. It is hoping that with further research in the applications of nonlinear neural network models in flood water level prediction would come out with more reliable network structures.

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Fazlina Ahmat Ruslan[#1], Ramli Adnan[#2], Abd Manan Samad[*3], Zainazlan Md Zain[#4]

[#]Faculty of Electrical Engineering

[*]Dept. of Surveying Science and Geomatics, Faculty of Arc., Planning and Surveying

Universiti Teknologi MARA 40450, Shah Alam, Selangor, Malaysia

[1]fazlina419@salam.uitm.edu.my

[2]ramli324@salam.uitm.edu.my

9

Home Automation System Using Window Application with Voice and Email Control Methods

R.A.Ramlee, M.H.Leong, M.M.Ismail, M.A.Othman,
H.A.Sulaiman, M.H.Misran & M.A.Meor Said

ABSTRACT

This paper presents a wireless Home Automation System (HAS) that mainly performed by computer. The system is designed with several control methods in order to control the target electrical appliances. This various control methods implemented to fulfill the needs of users at home even at outside. The computer application is designed in Microsoft Windows OS that integrated with speech recognition voice control by using Microsoft Speech Application Programming Interface (SAPI). The voice control method provides more convenience especially to the blind and paralyzed users at home. This system is designed to perform short distance control by using wireless Bluetooth technology and long distance control by using Simple Mail Transfer Protocol (SMTP) email control method. The short distance control is considered as the control that performed inside the house. Moreover, the long distance control can be performed at everywhere by devices that installed with browser or email application, and also with the internet access. The system intended to control electrical appliances at home with relatively low cost design, user-friendly interface and ease of installation.

Keywords – Home Automation, Smart home, Voice Control, Bluetooth, Email, SAPI

INTRODUCTION

The "Home Automation" concept has existed for many years. The system is developed quickly and becoming more popular in current market. Many of the researchers introduced various novelty ideas and concepts to be implemented in the system. Furthermore, the advancement of technology produces a lot of possibilities to the HAS. However, HASs are not always accepted by end users, especially the disabled and elderly due to their complexity and cost.

From the review of voice control HAS projects, [1] implements LD3320 voice chip based SI-ASR (speaker-independent automatic speech recognition) technology. [2] & [3] used SUNPLUS SPCE061A as speech recognition voice-controller in the system. The Environmental Control System (ECS) of [4] employs a universal remote control by MC68HCll-microprocessor chip and HM2007 voice recognition chip. [4] mentioned that the total estimate cost of the project should be under 200 US dollars.

Project [5] is mentioned as low cost speech recognition HA system. The design of [5] utilizes the open-source HTK toolkit, which implements a state-of-the-art Hidden Markov Models (HMM-based) speech recognizer and low-cost close-talking microphone. [6] implemented MATLAB application as the voice recognizer and then redirected to a voice recognition engine, Julius [7].

For the project [1] – [4], implementation of voice chip hardware in the system is able to build a standalone system but costly. Project [5] & [6] implemented voice recognizer software in computer, but it does increase the complexity in launching operation and reinstallation. [5] implemented HTK Toolkit and [6] implemented MATLAB as voice recognizer required user to prior install and launch those component before the main application is launched. Also, purchase of MATLAB license in [6] is an extra cost to the system.

The voice control feature of this system is designed with Microsoft Speech Application Programming Interface (SAPI) which is an API developed by Microsoft to allow the use of speech recognition and speech synthesis within Window application. The application compares incoming speech with an obtainable predefined dictionary. It is supported in Window XP, Vista, 7 and 8 OS and freely redistributable with any window application. The SAPI can integrate into the Windows GUI and launch together with the other applications. Also, SAPI is chosen because of the built-in voice database in the Microsoft Windows OS and the highest distribution of Microsoft Windows users in the current market.

By reviewing the HAS that perform the long distance control, [8] & [9] implemented internet network infrastructure to connect with the HAS. The internet control methods of [8] & [9] are mainly done by internet browser whereby a domain and web server is hosted. This method is not cost effective because a few bucks required to purchase a domain and the hosting plan usually spends several dollar to serve up the web page. [9] Implemented GSM and Internet to perform long distance wireless HAS control. The system implemented microprocessor and GSM SMS control method by a GSM modem. The long term cost of SMS charged by the telecommunication service provider is not fully accepted by every user.

The email control method is chosen to be implemented into the HAS. This is the free of charge internet control method that allows users to monitor and control the home appliances when they are not in the house. This long distance control can be performed everywhere as long as internet access is available. The email parsing function is designed in the system to read command in the received email. Although the email control method using SMTP required some delay time (up to few seconds) to receive a new email. However, it would still acceptable to be performed.

In term of cost, this system implemented low cost microcontroller, Bluetooth module and Relays as the system main core. The total cost of one unit of this system hardware is estimated less than 35 USD if the Microsoft Windows based computer is available and also computer built-in Bluetooth adapter is excluded. With this low budget, this system is still performed with powerful functions.

SYSTEM OVERVIEW

Figure 1 illustrates the overall control function of the system. The Bluetooth wireless connection enabled the system communicates with graphical user interface (GUI) on computer without cable. The target home appliances are controlled by the system Main Control Board.

In order to improve the standard living in home, this system provides three different types of control methods to the Main Control Board. The first control method is performed by clicking on Windows GUI by using mouse or touch pad. This method provides facility to the computer user to control the home appliances without walk to the switches on the wall. The second control method is speech recognition voice control. User is able to speech or gives command directly to

the microphone of the computer. A number of microphones can be installed in the surrounding of the house so that this method is able to assist the disabled people who have problem with locomotion difficulty.

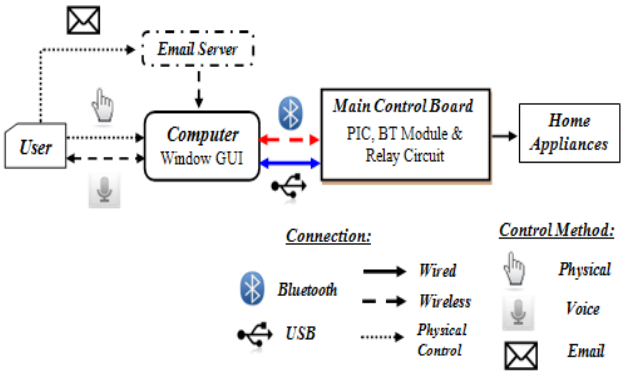

Figure 1: Functional Block Diagram of the System

The third method is long distance email control and monitoring. This method is performed by sending an email to particular email address whereby the specific commands are exist in the subject or content of the email.

The connection Computer Windows GUI and Main Control Board is designed with two types of connections (Primary and Secondary) to the system. In case of Bluetooth connection issue occurred between computer and control board, computer can connect to board by wired USB connection. The secondary connection is act as the backup solution in the system.

HARDWARE DESIGN

This section mainly discuss about the hardware construction of main control board. Figure 2 demonstrates the hardware block diagram in the main control board. PIC Microcontroller, PIC18F2550 is chosen due to its capability to perform the both serial and USB features to establish the Bluetooth and USB connection to the GUIs. For the Bluetooth module, low cost Cytron Bluetooth module, BlueBee is chosen to establish the Bluetooth connection between main control board and the GUI.

The electrical current is directly connect to the main control board whereby it separates the regulator and relay circuit. The voltage regulator is constructed by common reliable regulator circuit which consists of transformer, rectifier and regulator. 5V and 3.3V DC outputs are regulated in order to fulfill the voltage needs of the specific components in the main control board.

The ease of installation is taken into account for this system. The system is designed to directly install beside the electrical switches on the wall. The installation of this system eliminates the complex wiring reinstallation and overhead wiring on the wall. The existing switch connection is connected and controlled by the relay circuit inside main control board. Furthermore, multiple control boards can be installed in home because the Bluetooth master device in computer is mostly able connect up to 7 devices in a 'Piconet'[10]. With these simple and low cost components, the main control board is constructed in pretty small size but still performs the strong functions and features of the system.

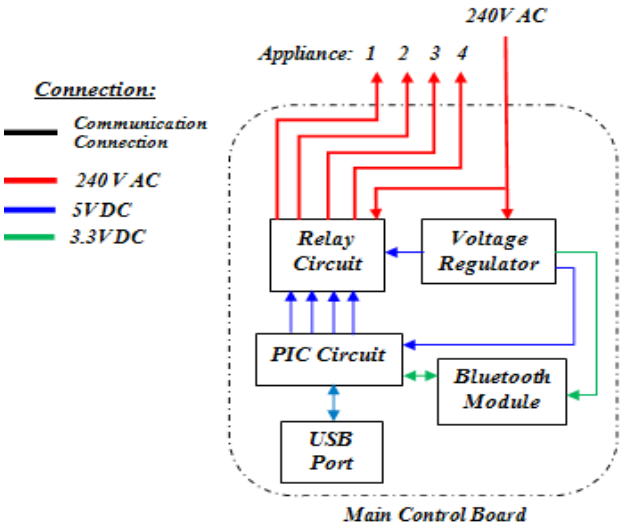

Figure 2: Main Control Board Hardware Block Diagram

The main control board is supplied by the household high AC voltage. The main control board implemented reliable transformer for the high voltage regulation circuit in order to supply current to the control board's components. The main control board is expected to operate continuously in 24 hours by implemented high quality voltage regulation and heat dissipation circuit design. Figure 3 shows the prototype of main control board that installed on an appliances board. The appliances board simulates the home appliances with two lamps and two bulbs. Except the lamp and light, this system is able to control other variety of electrical appliances that operate in two states (On/Off) switch function.

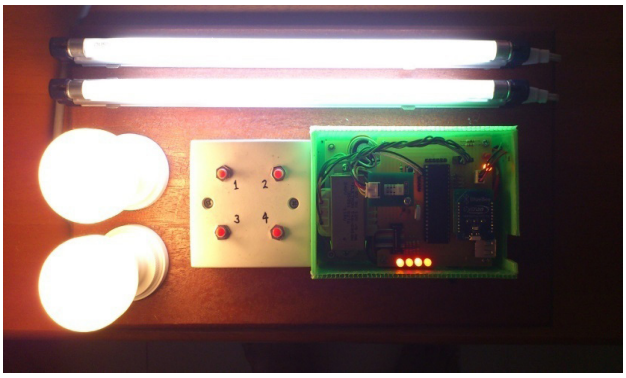

Figure 3: Prototype of Main Control Board with Target Appliances

SOFTWARE DESIGN

Software design section includes the main functions of the system designed in the PIC microcontroller and the Windows GUI.

Windows GUI

The Windows GUI is designed by Microsoft Visual Basic.NET application. The Windows GUI is designed with four different tabs, which are "Main Control", "Security", "Connection" and

"Response". All control function is performed in "Main Control Tab", "Security" tab embedded with IP camera interface, "Connection" tab allows user to configure the connection setting. "Response" tab is usually hidden because it is used for troubleshooting and maintenance purpose.

Main Control Tab

Figure 4 shows the user-friendly Main Control tab interface. The four bulbs indicated the appliances status that connected to the control board. User can simply click on the bulb to turn on/off the appliance. This interface is able to establish connection to main control board by Bluetooth or USB. When the interface is connected to the control board, the 'mail count' timer is activated to check the new received message for every few seconds.

Figure 4: Window GUI "Main Control" Tab

Security Tab

The "Security" tab is embedded with web browser. The web browser is designed to navigate to the particular IP address in order to grant access to the IP camera. Figure 5 below shows the Security tab that access to Panasonic IP Camera, BL-C131. This additional security function allows users especially disabled people to monitor the house.

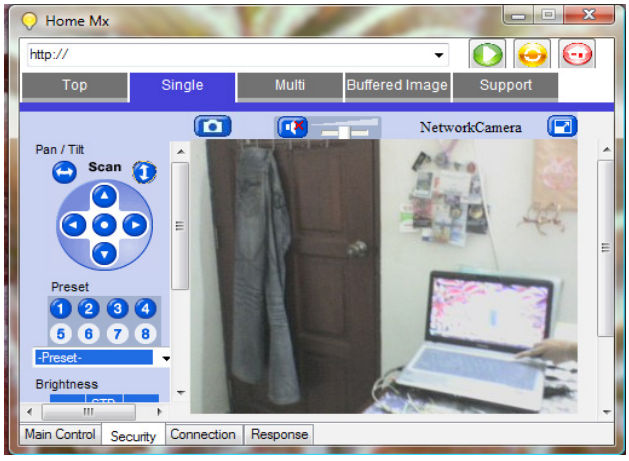

Figure 5: Window GUI "Security" Tab

Connection Tab

Figure 6 shows the designed "Connection" tab in Windows GUI. User able to configure connection setting in this tab. Main Control board is connected through serial connection by particular COM Port number from Windows GUI.

The computer's Bluetooth software and driver are usually installed by the manufacturer in order to operate the built-in Bluetooth adapter. Most of the Bluetooth software will reserve and fixed the paired device connection to particular COM port number. Hence, the connections setting of this system is usually not changing except the Bluetooth driver or software is reinstalled.

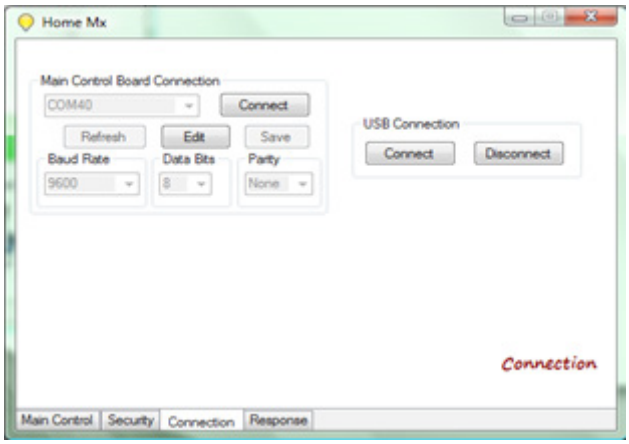

Figure 6: Window GUI "Connection" Tab

Response Tab

Figure 7 shows the Response tab in Window GUI. The control response window indicates the string data transmitted between Main Control Board and computer's Windows GUI through the serial connection. Voice response window indicates the voice input of the user and the voice response of the system. This tab is useful for connection and voice input monitoring.

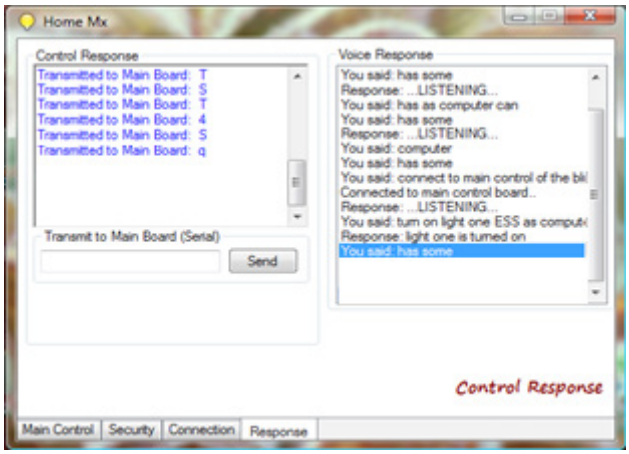

Figure 7: Window GUI "Response" Tab

Interactive Microsoft Virtual Agent

Microsoft Agent or MSAgent is an animated character that enables an enriched form of user interaction. Most of the MSAgent requirements are already installed on Windows OS computer.

These MSAgent character can freely move within the computer display, employs text-to-speech engine and also shows the movement and animations configured in the character .ACS extension file.

Apart of the default MSAgents in Windows such as 'Merlin', 'Genie', 'Robby' and 'Peedy', there are several companies designed private MSAgents that are compatible with Windows OS. The private agent is designed in more interactive and attractive ways that usually required purchase. Figure 8 shows the MSAgent, 'Jose' integrated into the Windows GUI. The 'Jose' agent is developed in year 2005 by Guile 3D Studio[11]. 'Jose' is designed in as a business young guy look with ultra realistic face and transparent background.

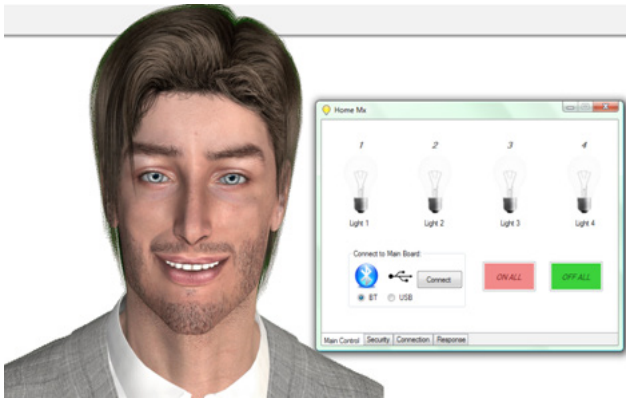

Figure 8: MSAgent 'Jose' in the System

Table 1 below indicates the example VB.NET assembly code implemented to load the MSAgent, 'Jose' into the Windows GUI.

Table 1: Example VB.NET Assembly Code to Load MSAgent

```
Private Sub Form1_Load(sender As System.Object, e As System.
EventArgs) Handles MyBase.Load

    msagentController = New AgentObjects.Agent
    With msagentController
       .Connected = True
       .Characters.Load("Jose", "Jose.acs")
       msagentCharacter = .Characters("Jose")
    End With

    With msagentCharacter
       .Show()  'Show the Agent character
       .MoveTo(10, 45, 0) 'move the Agent character position
       .Play("Smile")  'Play the smile animation
       .Speak("good day sir, please call me computer")
  End Sub
```

Voice Control

The input voice command by user is detected by computer's microphone. The initial state of the system is set as 'Sleep Mode'. The system requires to provide the 'wake up' command to activate the system and wait for further commands or instruction. The example of the 'activation command' set in this system is 'Computer'.

After the user actives the system by initially speak 'Computer' to the microphone. Then, the system is designed to listen for voice input commands within ten seconds after the system

is activated. Within the ten seconds, user can speak for particular command's keywords (Table 3) to activate the target appliances. The system will perform the control if the input sentences detected is match with the combination of keywords. 'Stop listening' command is able to let the system turn back into 'Sleep Mode'.

The keywords can be prior record into the predefined dictionary for high accuracy voice recognition to the commands. Table 2 shows the example of speech recognition function implemented in the Windows GUI.

Table 2: Speech Recognition Function in VB.NET Assembly Language

```
Private Sub SpeechEngine_SpeechRecognized(sender As Object,
e As System.Speech.Recognition.SpeechRecognizedEventArgs)
Handles SpeechEngine.SpeechRecognized

    If e.Result.Text.ToLower.Contains("computer") = True Then
       Timer4.Enabled = False
       listen_flag = True
       msagentCharacter.Speak("yes, sir")
       Timer4.Enabled = True '10 seconds timer
    End If
    If listen_flag = True Then
       If e.Result.Text.ToLower.Contains("stop listening") Then
          Timer4.Enabled = False
          listen_flag = False
          msagentCharacter.Speak("computer stop listening")
       End If
       If e.Result.Text.ToLower.Contains("one") = True And
e.Result.Text.ToLower.Contains("on") = True Then
          msagentCharacter.Speak("light one has turned on")
          'TURN ON LIGHT1 OPERATION
       End If
    End If
```

Table 3: Example Keywords of Voice Input Command

Target Appliances	Input Command (Keywords)			
	On	Off	On All	Off All
Light 1	"on"& "one"	"off"& "one"	"on"& "all"	"off" & "all"
Light 2	"on"& "two"	"off" & "two"		
Light 3	"on"&"three"	"off"&"three"		
Light 4	"on"& "four"	"off"& "four"		

The example keywords indicated in Table 3 are designed for four light appliances. Hence, only combination of two keywords is set into the prototype system. For the case of different target appliances, more keywords can be added as the commands in order to differentiate them.

Email Control

Email control method allows user to perform control and monitor to the home appliances at everywhere even not at home. This free of charge method provides long distance control with the SMTP.

Gmail provides a useful Gmail feed feature that allows user to subscribe to emails using feed reader supporting authentication. The designed Windows application implemented the Gmail feed to capture the received unread mail.

Gmail feed is an ATOM feed, the response is parsed as a normal XML file using 'XMLDocument'. Once XML message is received, the application checks, assigns and stores the unread message details in an array. 'Email Count' timer implemented to check the new message for every few seconds.

Table 4: Example of Email Commands

Target Appliances	Email Command	
	ON	OFF
Light 1	light1-on	light1-off
Light 2	Light2-on	light2-off
Light 3	Light3-on	light3-off
Light 4	Light4-on	light4-off
All Lights	all lights-on	all lights-off

Table 4 shows the example of email commands implemented to control the target appliances at home. Table 5 shows the mail parser function that implemented to parse the keywords in the new received email and further perform the control and monitoring. More than one email commands can be combined by splitting the new code with the symbol "; ".

Table 5: Example of Mail Parser Function

```
Private Function MailParser() As Boolean
    Dim Code As String() = Split(newCode, "; ")
    Dim a As Integer

    For a = 0 To Code.Length - 1
      If Checker(Code(a)) Then 'check format of code
        Dim header1 As String = Mid(Code(a), 1, 10)
        Select Case header1
          Case "CHECK"
            If ConditionCheck() Then
              newCode = emailMessages(0)
              SendMail()
            End If
          Case "LIGHT1-ON"
            'TURN ON LIGHT1 OPERATION
          Case "LIGHT1-OFF"
            'TURN OFF LIGHT1 OPERATION
        End Select
      End If
    Next a
  End Function
```

RESULT

The graph in Figure 9 shows the Windows GUI's voice recognition response accuracy. The test conducted by 50 people with five different voice commands. Furthermore, the test was repeated for the same people with prior voice command recording. The five types of commands are referred to the example shown in Table 3.

From Figure 9, the result clearly states that prior recording of keywords produced percentage average of 96.2% is effectively to be implemented.

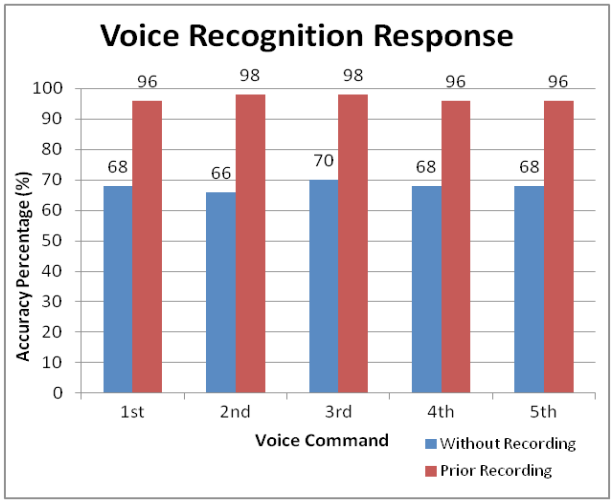

Figure 9: Voice Recognition Response Graph

CONCLUSION & FUTURE WORK

In conclusion, free of charge email control method perform long distance monitoring and control for the home appliances. Moreover, implementation of wireless Bluetooth connection in control board allows the system install in more simple way. The easy to use voice control method on Window GUI provides simple control especially for the elderly and disabled people.

In term of platform capability, this system is only suitable for Microsoft Windows OS in computer. The same software is suggested to design for the other OS in computer such as Linux, MAC and etc, so that more platforms are able to support this application.

The email control method utilizes third-party service by Google mail's atom feed. If the server has down or profile changed, this system needs to be reconfigured or find for replacements of those services. Hence, making a stand-alone system is the solution to eliminate the problem. However, it does increase the overall cost of the system to create an own server online.

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R.A.Ramlee
Faculty of Electronics and Computer Engineering,
University Technical Malaysia Malacca (UTeM)
Durian Tunggal, Malacca, Malaysia
Email: ridza@utem.edu.my

M.H.Leong, M.M.Ismail,
M.A.Othman, H.A.Sulaiman
M.H.Misran & M.A.Meor Said
Faculty of Electronics and Computer Engineering,
University Technical Malaysia Malacca (UTeM)
Durian Tunggal, Malacca, Malaysia

10

Influence of Water/Binder Ratio on The Performance of Quarry Dust Fine Powder (QDFP) Concrete

Kartini, K. & Norhana, A.R.

ABSTRACT

Efforts for sustainable development are needed for economic and environmental impacts. This present work facilitates the development of concrete with a lesser environmental impact hence contributes to developing construction in a sustainable way. This paper reported the study carried out on the suitability of the quarry dust fine powder (QDFP) as waste materials obtained from grinding of quarry dust (QD) resulting from crushing of coarse aggregates quarrying activities. QDFP is classified as artificial pozzolan of siliceous material Class N as mentioned by ASTM C618-2003, therefore suitable to be used as partial cement replacement for sustainability. The performances of QDFP concretes on 7, 28, 60, 90 and 120 days of water curing were assessed through its compressive strength, rebound numbers (RN), water permeability and water absorption. The percentage amount of Ordinary Portland cement (OPC) replaced with QDFP are 3%, 5%, 10% and 15% by weight of binder at different w/b ratio *i.e.* 0.3, 0.4, 0.5 and 0.6. The results showed that by increasing the replacement of QDFP in higher proportion (up to 15%) and with increasing w/b ratio from 0.3 to 0.6, the compressive strength and RN of QDFP concretes were decreasing, while the coefficient of permeability and percentage of water absorption of QDFP concrete were increased as the replacement of QDFP increased and with increased in water binder ratio (w/b). However, it can be generally concluded that the QDFP can be utilized in replacing cement in concrete production.

Keywords: Ordinary Portland Cement, Quarry Dust Fine Powder, Compressive Strength, Rebound Number, Water Permeability, Water Absorption.

INTRODUCTION

During this century, the environmental issues associated with CO_2 play a leading role in the sustainable development of the cement and concrete industry (Nurdeen, 2010). The production of Portland cement contributes to release of a significant amount of CO_2 during clinker burning process hence leads to global warming, and thus allow the environments to become warmer. The enormous production of CO_2 consequently contributes to absorption of solar radiation that will give rise to the temperature, that contributes to greenhouse effect. The properties of by-products and waste materials have been looked into to compare with the existing ordinary Portland cement (OPC) to be used in concrete in order to eliminate the environmental impacts. Karim (2011) reported that the use of by-products and waste materials as cement replacement would

eliminates the negative impacts of the cement industry and minimize the environmental impacts. Furthermore, partial replacement of OPC by a pozzolanic material generally has a desirable effect on the strength and the durability of mortar and concrete (Nasser, 2010). Therefore, it is necessary to look for sustainable solutions for future concrete construction. The substitution of the agriculture industrial waste by-products such as Saw Dust Ash (Kartini, Hamidah & Mahmud, 2007), Palm Oil Fuel Ash (Ahmad et al, 2008) Rice Husk Ash (Kartini, 2009), Empty Fruit Bunch Ash (Amizan & Kartini, 2009) and Sugar Cane Bagasse Ash (Guilherme et al, 2009) have been carried out to identify the suitability of the waste materials as partial cement replacement in concrete. In responding to this matter, this study focuses on utilization of QDFP as an alternative material for partial cement replacement with the objective to determine the optimum replacement of QDFP to OPC in making concrete.

EXPERIMENTAL METHODS

Material Preparations

The Quarry Dust (QD) material was taken from a factory known as Negeri Roadstone Quarry in Negeri Sembilan, Malaysia. The production of QDFP is carried out by placing 5 kg of QD in Los Angeles (LA) machine together with 16 nos. of ball bearings. It was grinded for 5000 revolutions, in which after grinding, the crushed QD materials were sieved through 90μm to ensure its fineness.

Other materials

The other materials used in the concrete mixture were Ordinary Portland cement (OPC) Type 1. The fine aggregates used were mining sand with maximum size of 5 mm, while the coarse aggregates used wee crushed granite passing through 20 mm and retained on 10 mm sieve. The superplasticizer (Sp) named Rheobuild 1100 which composed of sulphonated naphthalene formaldehyde condensed polymer based admixture was used in order to ensure the consistency of the fresh concrete. The tap water free from contamination was used for the mixing and curing purposes.

Mix Proportions

The mixes were designed using DOE Method (Department of Environment, 1998), and from there onwards five (5) series of mixes were batched according to the water binder (w/b) ratio of 0.3, 0.4, 0.5 and 0.6. Different percentages replacement of OPC with QDFP were used *i.e.* 3%, 5%, 10% and 15% and designated as OPC, 3QDFPSp, 5QDFPSp, 10QDFPSp and 15QDFPSp respectively. The concrete specimens were cast as according to BS EN 12390-1:2000. Table 1 shows the mix proportions of OPC and QDFP concretes. The 100% OPC without Sp was cast as control mix with a slump of between 40 – 50 mm. For the QDFP concretes, the Sp was added to enhance the fluidity. The amount of water and the percentage of Sp were kept constant to ensure its consistency with a slump between 100-150 mm. For other materials used, the amount depends on the w/b ratio and the replacement of QDFP to OPC.

Table 1: Mix proportion of OPC and superplasticized QDFP concrete (Norhana & Kartini, 2010)

Designation	Cement (kg/m³)	QDFP (kg/m³)	Water (kg/m³)	w/b ratio	Sp (%)	Fine Aggregates (kg/m³)	Coarse Aggregates (kg/m³)	
							10mm	20mm
OPC	684	-	205	0.3	-	457	355	710
3QDFPSp	664	21	205		1.61	457	355	710
5QDFPSp	650	35	205		1.61	457	355	710
10QDFPSp	616	68	205		1.61	457	355	710
15QDFPSp	581	103	205		1.61	457	355	710
OPC	513	-	205	0.4	-	542	384	767
3QDFPSp	498	14	205		1.61	542	384	767
5QDFPSp	487	26	205		1.61	542	384	767
10QDFPSp	462	51	205		1.61	542	384	767
15QDFPSp	436	77	205		1.61	542	384	767
OPC	410	-	205	0.5	-	611	395	790
3QDFPSp	398	12	205		1.61	611	395	790
5QDFPSp	390	20	205		1.61	611	395	790
10QDFPSp	369	41	205		1.61	611	395	790
15QDFPSp	349	62	205		1.61	611	395	790
OPC	342	-	205	0.6	-	671	398	795
3QDFPSp	332	10	205		1.61	671	398	795
5QDFPSp	325	17	205		1.61	671	398	795
10QDFPSp	308	34	205		1.61	671	398	795
15QDFPSp	291	51	205		1.61	671	398	795

Test Methods

Sieve Analysis

The British Standard BS 812-103:1:1985 was used in determining the particle size distribution of fine and coarse aggregates. The grading curves of the fine and coarse aggregate conform and satisfy the grading requirement of BS EN 12620:2002. This is important as well graded aggregates influence the quantity of water and cement in concrete mix, whereby the smaller particle can fill the voids between the large particles, besides the consistency of the mix. The fineness modulus of fine aggregate obtained was 4.86 which describes that the fine aggregates were mainly of 600 μm size.

Slump Test

Slump test on the fresh concrete was conducted to determine the workability of the concrete which was in accordance to BS EN 12350-2:2000. The slump values obtained were shown in Figure 1. For the OPC concrete which is regarded as control mix, the targeted slump are between 40 – 50 mm, while for the QDFP concretes and with addition of Sp to ensure its consistency, the slump are kept between 100-150 mm.

Compressive Strength

The compressive strength test was conducted on the OPC and QDFP concretes as in accordance to BS EN 12390-4:2000. The 1000 kN capacity Compression Auto Test Machine with rate of load employed at 3.00 kN/m was used to break the specimens of 100 mm cubes. The strength performance of the cube specimens were taken at ages of 7, 28, 60, 90 and 120 days of water curing.

Schmidt Rebound Hammer

The rebound number (RN) values of the OPC and QDFP concretes were obtained from the rebound hammer which measured the surface strength of concrete. The hammer with a fixed amount of energy was applied by pushing the hammer perpendicularly against the test surface of 100 mm cubes. The test was conducted on the cube specimens taken at ages of 7, 28, 60, 90 and 120 days of water curing as in accordance to BS EN 12504-2:2001.

Water Permeability

The water permeability test conducted was based on BS EN 12390-8:2000. In this test, the cylindrical specimens of 150 Ø by 150 mm height were water cured for 7, 28, 60, 90 and 120 days before testing. The specimens were split-up into halves after undergone the applied pressure of 0.5 N/mm^2 for 3 days. The average depths of penetration of water were measured after about 5 to 10 minutes based on the dark spotted imprint on the splitted faces of the specimen. The depth of penetration obtained was then converted into the coefficient of permeability, K (m/sec) which is equivalent to that of Darcy's law using the expression as cited in the Concrete Society Technical Report No. 31 (1988) as shown below:-

$$K = \frac{e^2 v}{2ht} \qquad \text{.....Eq. 1.0}$$

Where K is the coefficient of permeability in m/sec, e is the depth of penetration of concrete in metres, h is the hydraulic head in metres (5 bars which equivalent to 51.075 m), t is the time under pressure in seconds and v is the fraction of the volume of concrete occupied by pores, assuming that the porosity of concrete (v) as 2% for normal concrete.

Water Absorption

The measurement of the water absorption was determined based on BS 1881-122:1983. At the age of 7, 28, 60, 90 and 120 days, the cylindrical specimens of 50 Ø by 100 mm height were oven dried to constant mass at 105 ± 5 ^{o}C for 72 ±2 hours. The specimens were then stored in the air-tight containers before subjected to test. In determining the percentage of water absorption, the specimens were immersed in water for interval of 30 minutes, 60 minutes, 120 minutes and 240 minutes. The water absorption expressed as increase in mass as percentage of dry mass is calculated as follows:-

$$W = \frac{wt - wi}{wi} \text{ x } 100\ \% \qquad \text{..... Eq. 2.0}$$

where, W is the percentage of water absorption after immersion, wi is the weight of specimen after oven dry in grammes and wt is the weight in grammes after immersion at time t.

RESULTS AND DISCUSSION

Properties of QDFP

In terms of fineness of QDFP, it was found that the QDFP has low specific surface area as the fineness obtained was 92.1% compared to OPC, 98.6%. According to ASTM C 618-2003, for ashes to be classified as Class N pozzolanic, the total of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3) should be 70% minimum and LOI of 10% maximum. The produced QDFP can be classified as mineral admixture of Class N used in cement and concrete as the total composition of these chemical were 87.05% and Loss on Ignition (LOI) obtained was 1.32%. Table 2 shows the chemical compositions of OPC and QDFP using X-ray Fluorescence test.

Table 2: Chemical Composition (%) of OPC and QDFP (Norhana & Kartini, 2010)

Chemical Composition	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MgO	CaO	Na_2O	K_2O	P_2O_5	MnO	SO_3	LOI
OPC	15.05	2.56	4.00	0.12	1.27	72.17	0.08	0.41	0.06	0.06	2.90	1.33
QDFP	69.96	12.81	4.28	0.22	0.44	1.84	0.51	8.12	0.20	0.10	0.20	1.32

Workability

From Figure 1, it shows that increasing of w/b ratio affects the workability of the concrete as the height of slump increases. The slumps obtained for 0.3, 0.4, 0.5 and 0.6 w/b ratio ranges from 38mm to 127mm, 40mm to 141mm, 45mm to 150mm and 51mm to 168mm respectively for the control OPC concrete. For QDFP concretes mixes, the inclusion of Sp was introduced in the mix as it was expected that the consistency of the fresh concrete were low, because of the presence of the QDFP particles increases the fine content in the concrete mixes. It shows that as the w/b ratio of the QDFP concrete increases, the workability also increases and it increases with increased of the percentage of replacement with QDFP. However, further studies have to be conducted on QDFP mixes without Sp, as the results revealed that it might not need to add Sp in order to tackle the workability issue in QDFP concrete.

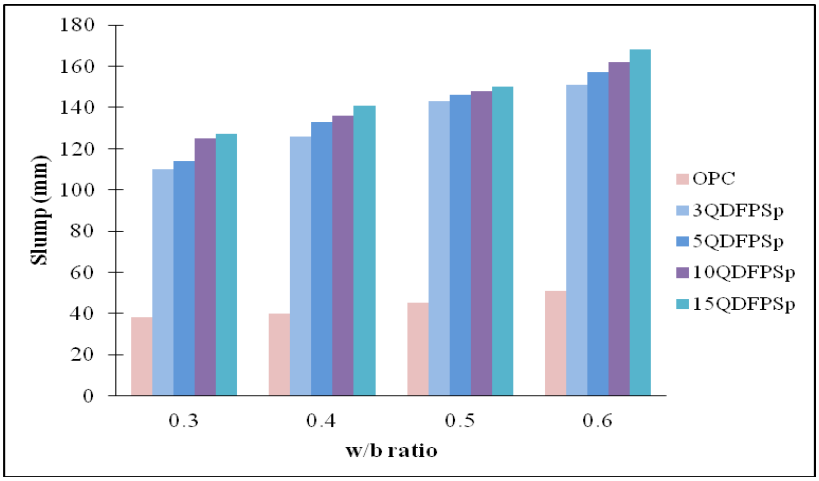

Figure 1: Slumps for OPC and QDFP concretes

Compressive Strength

Figure 2 shows the result of the compressive strength for OPC and superplasticised QDFP concretes taken at 28 days with different w/b ratio. It can be seen that the compressive strength of OPC concrete was higher compared to superplasticised QDFP concretes at all w/b ratio. This might be due to the fineness of OPC which is higher compared to QDFP concretes resulted in higher strength. Studies conducted by Shimizu and Jorillo (1990) and Chopra, Ahluwalia and Laxmi (1981) indicated that the fineness of cement have some influences, in which it increases the compressive strength of the hardened concrete.

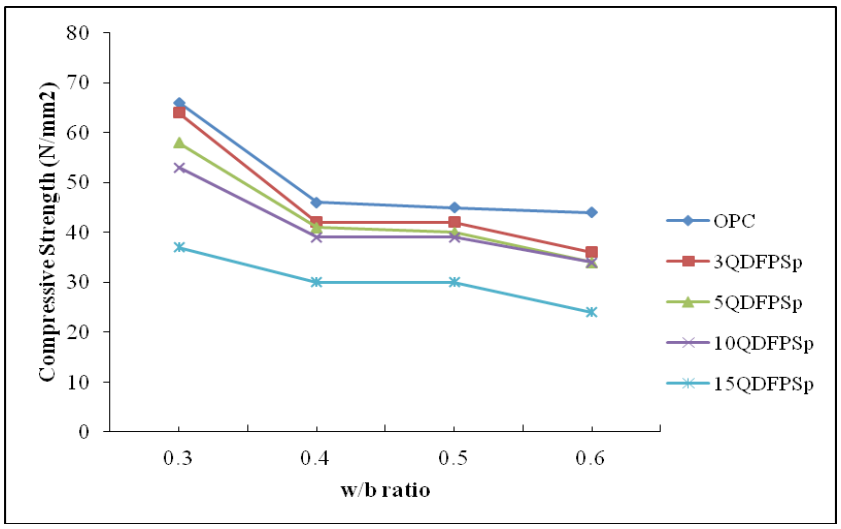

Figure 2: Compressive strength versus w/b ratio taken at 28 days of curing

It can also be seen that for OPC concrete, the increasing of w/b ratio from 0.3 to 0.6 showed decreasing in strength *i.e.* 66 N/mm^2, 46 N/mm^2, 45 N/mm^2 and 44 N/mm^2 respectively. These are true as the influence of moisture resulted in lower strength as suggested by Ikpong and Okpala (1992), *i.e.* the compressive strength of concrete decreases as the w/b ratio increases. Superplasticised QDFP concrete designated as 3QDFPSp, 5QDFPSp, 10QDFPSp and 15QDFPSp showed the strength ranges from 37 N/mm^2 to 64 N/mm^2, 30 N/mm^2 to 42 N/mm^2, 30 N/mm^2 to 42 N/mm^2 and 24 N/mm^2 to 36 N/mm^2 for 0.3, 0.4, 0.5 and 0.6 w/b ratio respectively taken at 28 days. It shows that the strength decreased as the w/b ratio increased and it also decreased with increased with the percentage replacement of QDFP. This again might be due to the amount of moisture in the mix resulted in lower strenth as suggested by Ikpong and Okpala (1992), while another possible reason might be due to the quality of QDFP itself, having low cementitious property.

Schmidt Rebound Hammer

Figure 3 shows the result of the rebound number for OPC, 3QDFPSp, 5QDFPSp, 10QDFPSp and 15QDFPSp taken at 28 days for 0.3, 0.4, 0.5 and 0.6 w/b ratio. It can be seen that the RN of OPC concrete is higher than the superplasticised QDFP concretes. The fineness of OPC enhances the strength of the concrete. This is because the high fineness of OPC increase the reactivity of OPC particles compared to the QDFP particles. The results are in line with the statement made by

Habeeb and Fayyadh (2009), whereby they stated that the increasing of fineness would increase the reactivity thus, enhances the strength of the concrete. The RN recorded for OPC concrete were 36, 35, 30 for 0.3, 0.4 and 0.5 which classified as having good hard layer and for 0.6 w/b ratio the RN was considered as fair. For superplasticised QDFP concrete, the increased in percentage replacement of QDFP from 3% to 15% contributed to lower RN. The decreasing of RN ranges from 34 to 30, 33 to 31, 29 to 25 and 22 to 17 for 0.3, 0.4, 0.5 and 0.6 respectively. The 3QDFPSp, 5QDFPSp, 10QDFPSp and 15QDFPSp for 0.3 and 0.4 w/b ratio can be classified as having good hard layer of concrete. However, the RN taken for 0.5 and 0.6 w/b ratio, the superplasticized QDFP can classified as fair and poor concrete.

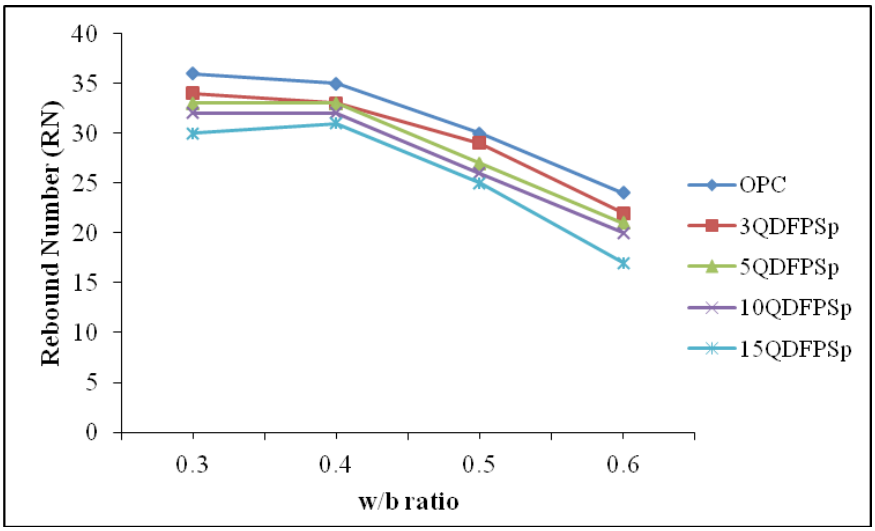

Figure 3: Rebound number versus w/b ratio taken at 28 days of curing

Water Permeability

Figure 4 shows the result of the coefficient of permeability for OPC, 3QDFPSp, 5QDFPSp, 10QDFPSp and 15QDFPSp taken at 28 days for 0.3, 0.4, 0.5 and 0.6 w/b ratio.

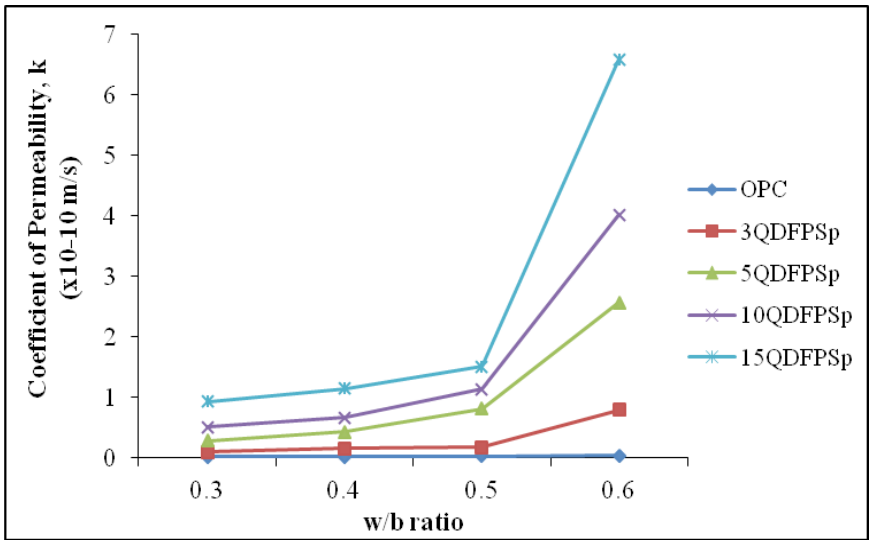

Figure 4: Coefficient of permeability versus w/b ratio taken at 28 days of curing

It can be seen from the graph that the coefficient of permeability for OPC control concrete were lower compared to the superplasticised QDFP concrete. That might be due to the finer fineness of OPC retained on 90 μm which was 1.4% compared to QDFP which was 7.9%. The coefficient of permeability for w/b ratio of 0.3, 0.4, 0.5 and 0.6 taken at 28 days for OPC concrete were 0.0135 x 10^{-10} m/s, 0.0209 x 10^{-10} m/s, 0.0219 x 10^{-10} m/s and 0.0374 x 10^{-10} m/s. While, for the superplasticised QDFP concrete at replacement of 3% up to 15% taken at 28 days for w/b ratio of 0.3, 0.4, 0.5 and 0.6, the coefficient of permeability ranges from 0.0982 x 10^{-10} m/s to 0.9232 x 10^{-10} m/s, 0.1576 x 10^{-10} m/s to 1.1478 x 10^{-10} m/s, 0.1717 x 10^{-10} m/s to 1.5075 x 10^{-10} m/s and 0.7860 x 10^{-10} m/s to 6.5881 x 10^{-10} m/s respectively. It can also be seen that the coefficient of permeability of QDFP concrete increased as the w/b ratio increased from 0.3 to 0.6. This is in line with the statement by Neville (2002), that stated the coefficient of permeability increases as the w/b ratio increases. The 0.6 w/b ratio recorded the highest coefficient of permeability. This might be due to the large amount of water in the mixes thus, resulted in excess of pores after water dries up. Results of Hwang and Wu (1989) indicated that with higher w/b ratio, water permeability will be higher. According to Neville (2002), for coefficient of concrete with 10^{-11} m/sec or 10^{-12} m/sec, it can be considered as having a very low permeability, hence with QDFP concretes having coefficient of concrete of 10^{-10} m/sec can be considered as pozzolanic material which having low permeability.

Water Absorption

Figure 5 shows the percentage of water absorption of OPC, 3QDFPSp, 5QDFPSp, 10QDFPSp and 15QDFPSp taken at 28 days for 0.3, 0.4, 0.5 and 0.6 w/b ratio. It can be seen that the water absorption for OPC control concrete was lower compared to the superplasticised QDFP concrete at all w/b ratio and with percentage replacement level of 3% to 15%. The percentage of water absorption of OPC recorded were 1.25%, 2.17%, 2.92% and 4.07% for 0.3, 0.4, 0.5 and 0.6 w/b ratio respectively. Meanwhile, the percentage of water absorption of 3QDFPSp, 5QDFPSp, 10QDFPSp and 15QDFPSp taken at 28 days for 0.3, 0.4, 0.5 and 0.6 w/b ratio ranges from 1.60% to 1.90%, 3.15% to 3.79%, 3.35% to 4.27% and 4.79% to 5.58% respectively. It shows that the percentage of water absorption increased as the w/b ratio increased. This might be due to the fact that when the amount of water in the mix increases, the production of pores also increases, therefore creating the capillary pores and air voids, which on the other hand will influenced the concrete durability to a large extent (Muhamed Sutan, Hamdan & Jin, 2002). The replacement of QDFP with 3%, 5%, 10% and 15% still achieved the required absorption of good quality concrete as the percentage of water absorption were below than 10% by mass as reference made to Neville (2002), who stated that the performance of good quality concrete should be less than 10% absorption by mass.

PERFORMANCES CORRELATION RELATIONSHIPS

Correlation relationships between compressive strength and rebound number

Figure 6 shows the linear correlation graph of compressive strength and RN obtained for OPC and superplasticized QDFP concrete taken at 28 days. It shows that the compressive strength increases as the RN increases. The graph of regression shows that the correlation of OPC and QDFP concretes can be considered as good as the coefficient of magnitude, R recorded were

0.597 and 0.664. The linear graph was chosen for the relationship based on Samarin and Meynink (1981), in which they stated that the correlation relationships between the compressive strength and RN can exist in a linear form *i.e fc* =a_0 + a_1RN.

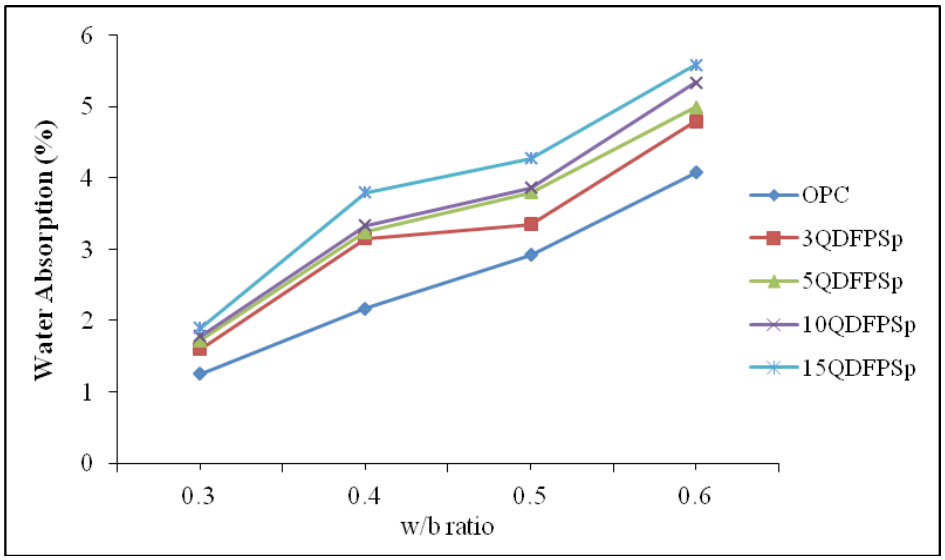

Figure 5: Percentage of water absorption versus w/b ratio taken at 28 days of curing

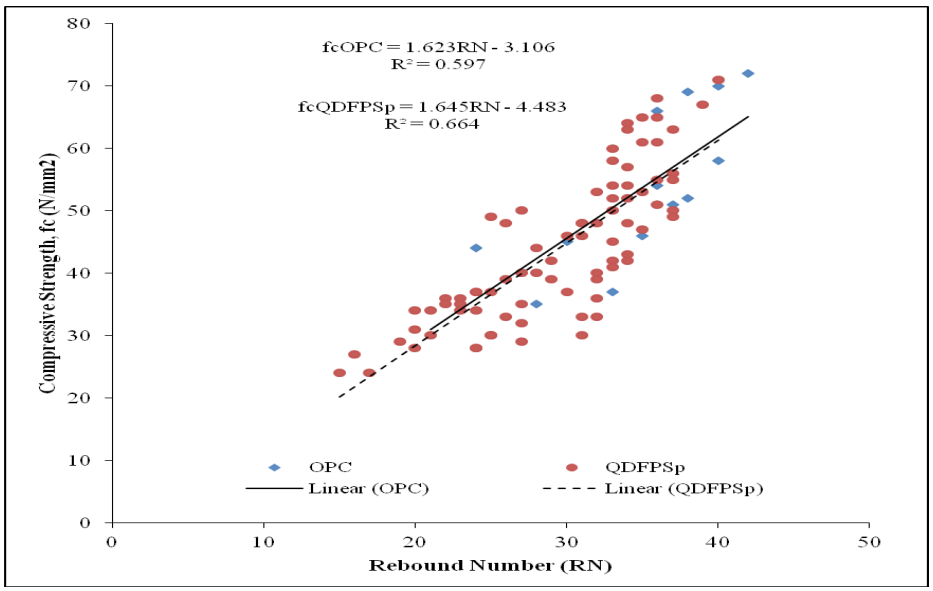

Figure 6: Relationships between compressive strength and rebound number at 28 days of water curing

Table 3 shows the estimated surface strength for OPC concrete taken at 28 days for 0.3, 0.4, 0.5 and 0.6 based on the obtained RN. The values for OPC concrete were 57%, 77%, 58% and 36% respectively, while for superplasticised QDFP concretes were ranges from 52% to 70%, 76% to 93%, 57% to 60% and 33% to 39% respectively. It shows that the estimated surface strengths obtained were much lower than the actual cube compressive strength. This is true as the surface strength were taken only at 30 mm from the surface as according to the standard.

Table 3: The estimated surface strength of OPC and superplasticised QDFP concretes

Mixture Designation	w/b ratio	Estimated Surface Strength (N/mm²)	Actual Cube Comp Strength (N/mm²)	Estimated / Actual %
OPC	0.3	37.5	66	57
3QDFPSp		33.5	64	52
5QDFPSp		31.8	58	55
10QDFPSp		29.5	53	56
15QDFPSp		26.0	37	70
OPC	0.4	35.5	46	77
3QDFPSp		31.8	42	76
5QDFPSp		31.8	41	78
10QDFPSp		29.5	39	76
15QDFPSp		28.0	30	93
OPC	0.5	26.0	45	58
3QDFPSp		24.0	42	57
5QDFPSp		21.0	40	53
10QDFPSp		19.5	39	50
15QDFPSp		18.0	30	60
OPC	0.6	16.0	44	36
3QDFPSp		14.0	36	39
5QDFPSp		12.0	34	35
10QDFPSp		11.0	34	32
15QDFPSp		8.0	24	33

Correlation relationships between compressive strength and water permeability

From Figure 7, the correlation relationships between the compressive strength and coefficient of permeability exists through power graph. It shows that the compressive strength increases as the coefficient of permeability decreases. The graph of regression shows that the correlation of OPC and QDFP concretes can be considered as good as the coefficient of magnitude, R recorded were 0.497 and 0.550.

Correlation relationships between compressive strength and water absorption

From Figure 8, the correlation relationships between the compressive strength and water absorption exists through linear graph. It shows that as the compressive strength increases, the percentage of water absorption decreases. The graph of regression shows that the correlation of OPC and QDFP concrete were good as the coefficient magnitude, R recorded were 0.728 and 0.694, which were close to unity.

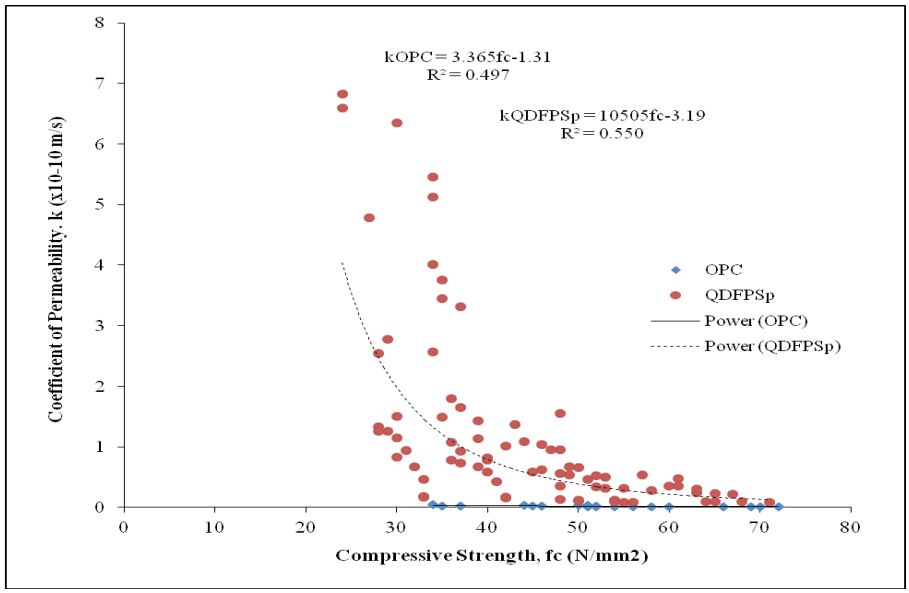

Figure 7: Correlation relationships of coefficient of permeability versus compressive strength at 28 days of water curing

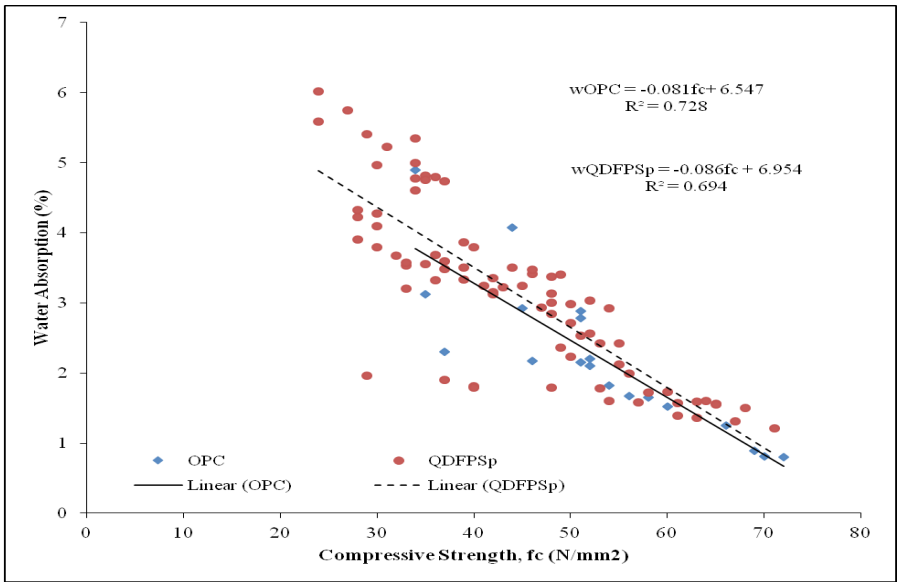

Figure 8: Correlation relationships of water absorption versus compressive strength at 28 days of water curing

CONCLUSIONS

From the investigation carried out, the following conclusions were made:-

1. QDFP has a higher percentage of oxide composition of SiO_2 that is almost 70%, which is four times higher than OPC and can be classified as mineral admixture of Class N as the total composition of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3) were 87.05% and LOI obtained was 1.32%.
2. Replacement of QDFP in higher proportion and increasing of w/b ratio from 0.3 to 0.6 reduces the compressive strength of the concrete, with optimum replacement of QDFP chosen was 15%.

3. The increasing percentages replacement of QDFP from 3% to 15% and increasing w/b ratio from 0.3 to 0.6 reduces the RN, however still can qualified as having poor to very good hard layer of concrete.
4. The replacement of QDFP in higher proportion (up to 15%) and increasing the w/b ratio from 0.3 to 0.6 increases the coefficient of permeability. However, the values of the coefficient permeability of ODFP still can be considered as having low water permeability.
5. Replacement of OPC with QDFP and increased the w/b ratio from 0.3 to 0.6.increased the water absorption of the concrete, however, still satisfy the requirements of good quality concrete *i.e.* less than 10% absorption by mass.

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Kartini, K.
Assoc. Prof. Ir. Dr.
Faculty of Civil Engineering
Universiti Teknologi Mara
MALAYSIA

Norhana, A.R.
PhD student
Faculty of Civil Engineering
Universiti Teknologi Mara
MALAYSIA

11

Form-Finding Method of Tensioned Fabric Structures

H.M. Yee & K.K. Choong

ABSTRACT

The purpose of form-finding for tensioned fabric structures is to determine the structural form that satisfies the pre-defined stress system and boundary condition. Various methods for form-finding have been proposed. In this paper, the reviewing process of form-finding methods of tensioned fabric structures has been carried out. There are advantages and disadvantages regarding the computational method for solving form-finding problem. Despite all computational form-finding development, nonlinear analysis is worth reviewing based on the reason that it is easily available in any conventional FE program with capability for initial stress input can be effectively used and the method can be used for both the initial equilibrium problem and the subsequent load analysis. Furthermore, nonlinear displacement method can be used starting from an assumed shape which takes into account mechanics of tensioned fabric structures. Such generation of assumed shape can be easily carried out using FE software or any other software capable of geometry generation and meshing of surfaces. Starting from initial equilibrium shape with anticlastic feature, it is expected the problem of high distortion of element encountered can be overcome. Form-finding on tensioned fabric structures using nonlinear displacement method in combination with properly formulated numerical strategies to overcome the disadvantages is able to render the proposed method as a simple tool for form-finding to be used by structural designers.

Keywords- Form-finding; Nonlinear Displacement Method; Tensioned Fabric Structures

INTRODUCTION

Tensioned Fabric Structures (TFS) are structures that are composed of tensioned fabric as structural members. Fabric patterns are joined together at seams and are tensioned through mechanical means or cables to rigid supporting system to typically provide a roofing structure. Fig. 1 shows a sketch of a tensioned fabric structure.

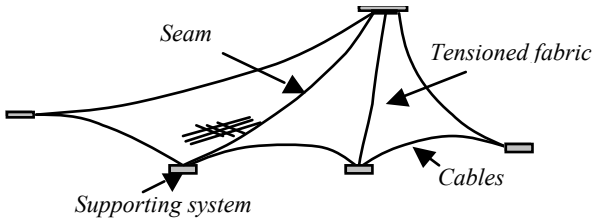

Figure 1: Basic components of a tensioned fabric structure

Due to the flexibility of architectural fabric used, a great variety of surface form can be realized using TFS. Nevertheless, for the structure to function satisfactory, its initial equilibrium shape has

to be first determined. Analysis of tensioned fabric structures starts with form-finding. It is an important step in order to ensure that the form of a TFS has the needed stiffness to resist external loading. Other than the requirement from structural aspect, form-finding is also important for checking the viability of form desired by architects. Various form-finding computational methods have been developed to assist engineers in the design of TFS. Many technical procedures and algorithms have been developed to find the structural form under prescribed initial tension and supporting system. The procedures can be roughly sorted into three groups: force density methods; dynamic relaxation method; non-linear displacement method. The other form-finding computational methods were extended or modified from the above three groups.

The common objective in all methods is the determination of a structural form which is in self equilibrium. The main difference among all methods lies mainly in how to determine the unknown initial equilibrium shape from a properly assumed initial assumed shape. This determination of the unknown initial equilibrium shape is complicated by the fact that the process is nonlinear.

NONLINEAR DISPLACEMENT METHOD

Haug and Powell [1] have developed a nonlinear displacement method for the form-finding of cable nets. Applications of nonlinear displacement method to the shape design of cable nets represented by straight truss members. They have subsequently presented a special prestressed quadrilateral element which is stretched independent and always remains in an isotropic stress state of specified magnitude for the purpose of form-finding. Argyris et al. [2] have used the nonlinear displacement method to solve the initial equilibrium problem for cable nets. Their method was developed in order to find the form of the cable roofs at the 1972 Olympics in Munich. Straight bar elements were used to represent the cables. Fujikake et al. [3] have presented a method of nonlinear analysis of TFS, which was implemented in the ADINA [4] program. They have used an updated Lagrangian formulation to include displacements in the load. Form-finding was performed using a technique with a small Young's modulus. Tabarrok and Qin [5] have described large deformation FE analysis for form-finding and load analysis of tension structures made up of membranes, cables and frames. Minimum surface method, nonuniform stress surface method and nonlinear displacement method were presented for form-finding of the initial equilibrium configuration. The behaviour of tension structures under a variety of loading conditions including snow and wind loads was also investigated. The complete set of procedures for both form-finding and load analysis functions were implemented in a program and verified through applications to typical tension structures. Cheong [6] has carried out form-finding using stress analysis program for TFS based on nonlinear displacement method. The study concluded that a stress analysis program based on nonlinear analysis could be effectively used for form-finding, provided that the material properties are controlled. Range of 2.5% to 10% from the actual values of modulus of elasticity is adopted in the study by Cheong [6].

Yee [7] have proposed nonlinear displacement method in combination with properly formulated numerical strategies to overcome the disadvantages is able to render the proposed method as a simple tool for form-finding to be used by structural engineers. As a first shape for the start of form-finding analysis procedure adopted in Yee [7] study, initial assumed shape is needed. For the generation of such initial assumed shape, knowledge of the requirement of anti-

clastic nature of tensioned fabric surface is used. Anti-clastic feature is incorporated into the model in order to produce a better initial assumed shape. Sag has been specified for producing anti-clastic feature in the initial assumed shape of model of TFS.

Two stages of analysis were involved in the procedures of form-finding analysis in one cycle. The first stage (denoted as SF1) is an analysis which starts with an initial assumed shape in order to obtain an updated shape for initial equilibrium surface. This is then followed by the second stage of analysis (denoted as SS1) aimed at checking the convergence of updated shape obtained at the end of stage SF1. During stage SF1, artificial tensioned fabric properties, namely elastic modulus E with very small values, are used. Both warp and fill tensioned fabric stresses, W and F are kept constant. In the second stage SS1, the actual tensioned fabric properties values are used. Resulting warp and fill membrane stresses are checked at the end of the analysis against prescribed tensioned fabric stresses. Iterative calculation has to be carried out in order to achieve convergence. The criteria adopted is that the total warp and fill stress deviation should be ≤0.01. The resultant shape at the end of iterative step n (SSn) is considered to be in the state of initial equilibrium under the prescribed warp and fill stresses and boundary condition if difference between the obtained and the prescribed tensioned fabric stresses relative to the prescribed stress is negligibly small.

Yee et al. [8] have carried out form-finding of surface in the form of Möbius strip and Enneper minimal surface using nonlinear displacement method. Comparison between soap film models through experimental form-finding with surfaces defined by Möbius strip and minimal surface Enneper are studied. Yee and Choong [9] have used the nonlinear displacement method for form-finding of TFS in the form of Möbius strip.

FORCE DENSITY METHOD

Force density method was originally developed for the form-finding of cable structures by Schek [10]. The force densities are very suitable parameters for the description of the equilibrium state of any general net. Haber and Abel [11] have extended the force density method for form-finding of membrane structures. It was shown to be a special case of the assumed geometric stiffness method where both the reference shape and prestress distribution are unknowns in the solution. They have described the initial equilibrium problem for tension structures and presented a variety of methods for solving it. Two least squares techniques have been presented in which the prestress distribution in the reference configuration is the problem unknown and the reference shape is explicitly defined by the designer. The method was extended to triangular membrane element which was called surface stress density by Maurin and Motro [12]. The formulation draws a parallel with the force density method and a combined approach may be specified. Véron et al. [13] have used force density method to carry out the form-finding for the integrated design of TFS. Force density was increased or decreased in several bars corresponding to area of interest which allowed the users to adapt the fabric structure by producing taut or loose shape. Tibert [14] has presented force density method in detail and applied the method to a number of different types of cable roof structures. Linkwitz [15] has developed Stuttgart-direct-method where least squares, graph-theory, numerical mathematics were used together and connected to force density method. Linkwitz [15] has described the process of form-finding for prestressed and hanging structures and discussed the direct and indirect solution. Maurin and Motro [16] have presented

a method based on an energy criterion, by writing out the potential strain energy of the system and by using Lejeune-Dirichlet's theorem.

Montes et al. [17] have presented an important property of the force density method where only the connectivity of the nodes is necessary for the solution of the problem without the initial position of the nonfixed nodes of the structure. Accordingly, a mapping method was presented which is based on topology. It is in contrast to the mapping methods which are based exclusively on geometry. It is pointed out that the most important contribution of this method is that an initial assumed of the equilibrium position is not needed as part of the solution process due to the mapping in topology. Pauletti [18] has proposed an extension of the concept of force density which was called natural force density concept. It is claimed that the presented method is easily implemented into a linear structural analysis program and appropriate to generate good initial guesses for nonlinear analysis required during through design of tensioned structures. Sanchez et al. [19] have introduced a method combining a structural form-finding with a surface-fitting method to obtain preliminary shapes of tensile structures in real time. A multi-step force-density method was presented which allows the possibility of equilibrium shapes with smooth stress distribution to be obtained. The proposed method for the design of tensile structure is a fast and easy way to obtain different membrane shapes in real time.

Pauletti and Pimenta [20] have presented an extension of the force density method which has been called the natural force density method for the initial form-finding of cable and membrane structures, which leads to the solution of a system of linear equations. An iterative natural force density method was used to find minimal surfaces. Pauletti and Pimenta [21] have further discussed the natural force density method. The method is able to cope with irregular triangular FE meshes. It also lead to initial configuration with a uniform and isotropic plane Cauchy stress state. Gellin and Pauletti [22] have explored the form-finding of tensioned fabric cone structures using natural force density method. The natural force density method was tested with fixed ratios of the initial stresses. Stress density has been checked by using iteration method. Miki and Kawaguchi [23] have extended force density method to form-finding of tension structures. The extended method has been applied in the form-finding of prestressed structures with compression members. The extension was derived by generalizing the functional related to force density method. The method is able to find a form of complex tension structures which combine cables, tension membrane and compression members.

In form-finding analysis, the targeted solution is unknown. When finite element based approach is used, a model representing the geometry of the problem is required. Since the geometry is unknown, approximation to the geometry is required. The accuracy of the approximation is then iteratively improved until the initial equilibrium shape is found. In force density method, representation of the geometry is not required. Instead, this geometry is sought as the solution to the problem. Due to this reason, it can be seen that research studies focusing on the use of force density approach has been actively pursued after 1990s.

DYNAMIC RELAXATION METHOD

Barnes [24] has proposed dynamic relaxation method for form-finding and fabrication patterning of wide span cable net and prestressed membrane roofs. The method is able to ensure stability in the situation of suddenly imposed high residuals. Gosling and Lewis [25] have investigated numerical

form-finding of minimal surface membranes. A curved quadrilateral FE was used to provide a numerical representation of a thin surface (structural membrane) established between fixed or flexible boundaries. They have applied finite element method (FEM) to the vector based dynamic relaxation algorithm. Various techniques have been proposed to improve the numerical stability of the solution algorithm. Barnes [26] has further described numerical procedures based on the method of dynamic relaxation with kinetic damping for the form-finding and fabrication patterning of wide-span cable nets and grid shells, uniform or variably prestressed fabric membranes and battened membrane roofs. A full description was given which accounts for cable or strut elements, membrane element and spline beam elements. All of these elements were implemented in their natural stiffness form which has been allowed for gross geometrical and material nonlinearity with automatic controls to ensure the stability and convergence of the method.

Wakefield [27], Zhang et al. [28], Gaspar and Hincz [29] have used dynamic relaxation method in form-finding of membrane structures, while Talvik [30] has used dynamic relaxation method in cable analysis. Wood [31] has discussed a simple technique to control mesh distortion during the form-finding of membranes when using dynamic relaxation method. Artificial truss members were introduced which have viscosity but without elasticity. Forces can be generated between the nodes of triangular mesh to restrain the tendency of the mesh to distort.

Brew and Lewis [32] have adopted dynamic relaxation method in minimal surface membranes. Han and Lee [33] have studied the stabilization process of unstable structures by using dynamic relaxation method. The process of evolution from unstable structures to stable structures was effectively analyzed using dynamic relaxation method. Catenary surface having an equally stressed surface was analyzed by using dynamic relaxation method. Cooper [34] has studied form-finding of cable and membrane structures in static equilibrium. The equations for static equilibrium were derived from the application of the calculus of variations to the principle of virtual work from a collapsed reference configuration. Restrictions on these equations lead to the 1 Dimension & 2 Dimension Laplace-Young equations and the well-known thin-walled pressure vessel formulas. Two computational procedures such as energy minimization and dynamic relaxation method were briefly summarized.

OPTIMIZATION METHOD

Stefanou and Nejad [35] have investigated optimization techniques for the analysis of cable structures with flexible supports. Optimization methods are those based on the minimization of the total potential energy. Baranger [36] has presented an optimisation and sensitivity analysis tools in order to improve the design process of three dimensional membrane shapes. Baranger and Trompette [37] have presented an optimisation tool devoted to fabric structures. It is claimed that the presented method is able to optimise the stress states.

Bletzinger et al. [38] have presented numerical methods to simulate the physical experiments with the most general technology of structural optimization. Bletzinger et al. [39] have studied a simulation of the generalized soap film experiment for the design of prestressed membranes. It was applied directly on the FE mesh. In-plane mesh regularization was achieved by updated reference strategy for the soap film simulation. It is claimed that the presented method is powerful and efficient tools to trace extremely large and non-convex design space.

UPDATED REFERENCE STRATEGY

Bletzinger [40] has proposed updated reference strategy which is a numerical continuation method to solve the initial equilibrium problem of TFS with minimal surfaces. Under this approach, an optimal solution corresponding to initial equilibrium state of TFS is sought by iteratively update the reference configuration used in the formulation similar to problem of path-following in nonlinear analysis to determine singular point. The solution procedures is started with an assumed reference state for the definition of stress. This reference configuration is then iteratively updated until the differences between successive solution is sufficiently small. Bletzinger and Ramm [41] have used the updated reference strategy to carry out form-finding of membrane structures. Bonet and Mahaney [42] have used updated reference configuration method to solve form-finding in membrane structures. They have introduced a method to minimise the mesh distortion during form-finding. Wüchner and Bletzinger [43] have presented the updated reference strategy for numerical form-finding of pre-stressed membranes. The singularities of the inverse problem were regularized by a homotopy mapping. A projection method was demonstrated for the form-finding of anisotropic pre-stressed membrane structures. Dieringer et al. [44] have presented updated reference strategy as a form-finding tool and cutting patterns of textile membrane structures. The method can be applied to any FE discretization of cable and membrane structures subjected to prestress or to the external loading.

DISCUSSION

From the above description, it can be seen that a lot of research studies have been carried out on TFS. There are some major weaknesses associated with the nonlinear displacement method for form-finding analysis. Argyris et al. [2] have stated that during the form-finding analysis, it is possible that several of the elements may come under compression. The specification of material properties (fictitious or real) represents unnecessary additional decision making for the designer. Haber and Abel [11] have mentioned that both the final shape and the stresses in the structure are difficult for the designer to control. It is again stated that there is possibility for some elements in the structure to end up in compression.

Force density method with its linear method is not possible to have control over the internal prestress of the net. Pauletti and Pimenta [20] have stated that focus on force density method is due to the reason that the method can be used to find viable configurations without the necessity to specify coordinates and starting shape for form-finding. The primary challenges in implementing the dynamic relaxation method were associated with selecting appropriate mass, damping and time step increments. If the dynamic properties are not appropriately defined, the dynamic analysis converge very slowly or may be unstable and diverge.

A study from Yee [7] has proven that nonlinear displacement method can be effectively used to solve form-finding problem. The difficulties to control the final shape and stress in form-finding analysis have been overcome by Yee [7]. During the stage for obtaining an updated shape for initial equilibrium surface, very small values of modulus of elasticity have been used and both warp and fill stresses have been kept constant. In the stage of checking the convergence of updated shape, the actual properties of tensioned fabric have been used and the resulting warp and fill

stress are checked against desired prestress. Iterative calculation is carried out until convergence is achieved.

The problem of the elements ending up in compression is overcome in this paper by keeping the prestress to be constant during stage SF1. The computational results show that the weaknesses have been able to be overcome and that nonlinear analysis method is proven to be a simple method of form-finding analysis which can yield sufficiently accurate results.

Instead of starting from a flat model, nonlinear displacement method proposed by Yee [7] can be used starting from an assumed shape which takes into account mechanics of TFS, i.e. the anticlastic feature of surface of TFS. Such generation of assumed shape can be easily carried out using FE software or any other software capable of geometry generation and meshing of surfaces. Starting from initial equilibrium shape with anticlastic feature, it is expected the problem of high distortion of element encountered can be overcome.

CONCLUSIONS

As can be seen from the above description, various methods for form-finding has been proposed since 1971. In all these methods, the problems of difficulties to control to final shape, mesh distortion and elements ending in compression associated with the original nonlinear analysis approach to solve form-finding problem have been eliminated. However, all these methods employed specialized procedures which might not be generally available to designer or available in standard finite element analysis program. On the other hand, nonlinear analysis method used by earlier researchers (Haug and Powell [1], Argyris et al. [2], Fujikake et al. [3] and Tabarrok and Qin [5]) to solve form-finding problem is simple in concept. The availability of nonlinear analysis option in standard FE analysis program can be fully made use. However, due to the approximate nature of the solution procedures in which form-finding problem is solved as stress analysis problem without external load, serious difficulties as mentioned earlier have been encountered. Nevertheless, with proper computational strategies from Yee [7], an approach for solving form-finding problem preserving the simplicity in concept of the nonlinear analysis method can be made available to designers of TFS.

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H.M. Yee
Faculty of Civil Engineering,
Universiti Teknologi MARA,
13500 Permatang Pauh, Pulau Pinang, Malaysia
yhooimin@yahoo.com

K.K. Choong
School of Civil Engineering,
Engineering Campus,
Universiti Sains Malaysia, Seri Ampangan,
14300 Nibong Tebal, Pulau Pinang, Malaysia
cekkc@eng.usm.my

12

AGVs as Automated Material Handling in The Flexible Manufacturing System

R.A.Ramlee, N.M. Jamal, M.M.Ismail, M.A.Othman,
H.A.Sulaiman, M.H.Misran & M.A.Meor Said

ABSTRACT

The paper shows the design of the Flexible Manufacturing Systems (FMS) in the production line. Production line can be classified either batch production or continuous production. The particular approach, overview of FMS with example design layout of manufacturing plant is discussed. Besides, this paper particularly focus on the modeling of the FMS with AGVs as tools of material handling, that involved in manufacturing process with the high production rate according to the signal transmitting. Hence, this modelling is referred to the FMS-200. The proposed design of FMS with the signal transmitting between the workstation and AGVs is exemplified with the illustrations.

Key Wordss— Flexible Manufacturing System, AGVs, FMS-200, Hydraulic Press, Signal Transmitting

INTRODUCTION

Overview

Nowadays, there are many industrial sectors have been developed with modern technology for production system. The industrial sectors have been increased rapidly with the efficient manufacturing techniques due to the competitive stance in the world market in order to fulfil the customer needs and wants. As a result, there are various new manufacturing ways have been introduced and developed according to the competition among the industrial community. As we know, in the middle of the 1960s, market competition became more intense. During 1960 to 1970 cost was the primary concern. Later quality became a priority. As the market became more and more complex, speed of delivery became something customer also needed. A new strategy was formulated: Customizability. The companies have to adapt to the environment in which they operate, to be more flexible in their operations and to satisfy different market segments [1]. Hence, Flexible Manufacturing Systems (FMS) is applied because the innovation of FMS became related to the effort of gaining competitive advantage. Flexible Manufacturing Systems (FMS) can be defined in many ways, which are a manufacturing systems composed by numerically controlled machine tools, industrial robots and buffers interconnected by a material handling system [2] and a complex mechanical system that capable of fabrication, machining, and assembly operations [3]. It may be integrated with material handling equipment and automated storage systems. FMS is usually applied in the production line either batch production or continuous production[4].

Batch production is a technique used in manufacturing, in which the object in question is created stage by stage over a series of workstations. While continuous production is a flow production method used to manufacture, produce, or process materials without interruption. Moreover, FMS is called flexible according to the capable of processing a variety of different part styles and production quantities can be adjusted in response to the changing demand patterns.

The benefits of FMS in comparison to the conventional approaches can be substantial and include minimum batch sizes, improved product quality, reduced manufacturing lead time, reduced labor requirements, and improved equipment utilization [5]. However, FMS has a disadvantage, which is their implementation cost. The basic components of FMS are workstations, material handling and computer control system. Hence, this paper just focused on the signal transmitting between the workstation and AGVs. AGVs are known as automated material handling in FMS. Material handling is defined as the movement, storage, protection and control materials throughout the manufacturing and distribution process including their consumption and disposal [6]. Then, there are four categories of material handling equipment include material transport equipment, storage systems, unitizing equipment and last but not least are the identification and tracking systems.

However, this paper concerned on the material transport equipment that is used to move materials inside a factory , a warehouse or other facility that can be depicted in Figure 1. Then, the material transport equipment consists of industrial trucks, automated guided vehicles, rail-guided vehicles, conveyers and hoists and cranes. Hence, this paper proposed an automatic guided vehicle (AGV) as automatic material handling in the flexible manufacturing system as well as can minimize the human power in the production line.

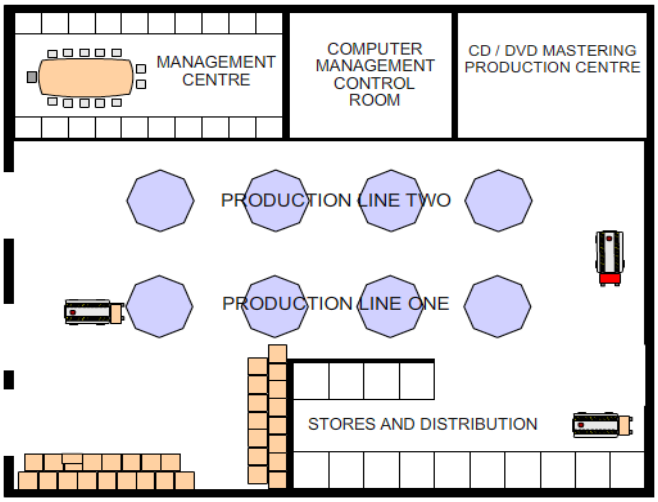

Figure 1: CD/DVD Manufacturing Facility

Thus, Automated Guided Vehicles (AGVs) are routinely used in industry FMS for material or parts handing [7]. AGVs are now familiar used in the plant due to their characteristics, which are independently or automatically operated, and self-propelled vehicles guided along defined pathway. They are powered by on-board batteries that allow many hours of operation which is 8-16 hour are typical before needing to be recharged [8]. Besides, the function of an automated guided vehicles system (AGVS) is to transport goods and materials between workstations and

storehouses of an automated manufacturing system. An AGVS is a set of cooperative driverless vehicles, used within the same manufacturing floor and coordinated by a centralized or distributed computer-based control system [9].

Since human power is limited and easy to be exposed to the dangerous, AGVs are proposed to be used to overcome that problem even they are highly cost. In addition, according to the Figure 1, the use of AGVS in the FMS has some properties need to be considered including guide-path design, determining vehicle requirement, vehicle scheduling, idle-vehicle positioning, and battery management[10]. The number of AGVs required is the sum of the total loaded and empty travel time and waiting time among other things due to congestion of the AGVs in a busy time period, divided by the time an AGV is available during that period[11]. In short, AGVs are used to perform the task for loading and unloading the parts between the workstations as well as many criteria need to concern in determining the number of vehicles. The use of AGVs can be controlled by signal transmitting between workstation and AGV in the FMS.

FMS-200

FMS is a flexible automation cell that allows the introduction of variations in the posts of which it is comprised towards adapting to the different requirements. There are eight stations involving a whole series of feeding, handling, verification and loading operation worked out using components from different technologies for smooth operations in FMS-200 [12]. All the components of which the FMS-200 is comprised are used in industry; in such a way that the user can work with real elements at all times making the learning process more meaningful. In FMS-200 system, each of the workstations is comprised of a structure based on aluminum profiles where the elements to carry out the corresponding process are located [13]. The front part includes the control unit which consists of the control panel and the PLC selected by the user. Hence, this paper focuses on the station three which is hydraulic press as shown in the Figure 2.

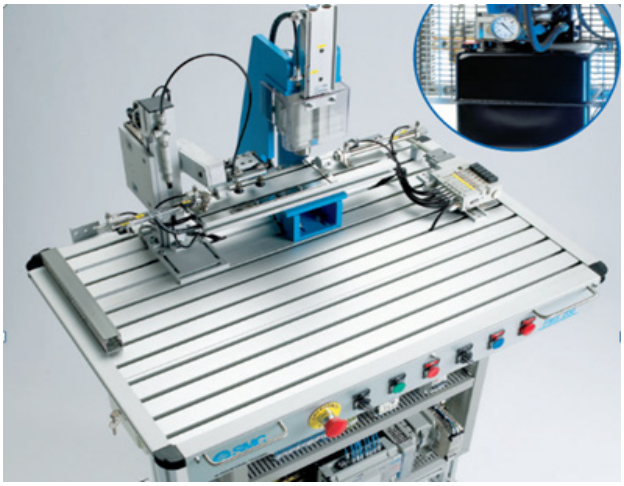

Figure 2: Hydraulic Press

This phase of the process carries out the hydraulic pressing of the bearing inserted in the previous station. The pressing is simulated to facilitate the subsequent disassembly of the components and their reuse. Nevertheless, all the elements comprising the module are completely

industrial. The lower part of the station contains all of the hydraulic equipment which is required to feed the pressing cylinder with high pressure oil. The FMS-203 station includes the following work modules:

Insertion/ extraction of the product in process

The handling and transfer of the product in process is carried out using a pneumatic rotary actuator which includes an arm with four vacuum pads. These have to transfer the part using vacuum. The handling device includes a mechanism based on pinion and ribbed belt to constantly keep the part in the same position.

Feeding the press

Two double acting pneumatic cylinders transfer the product in process from the transfer point to the pressing and vice versa.

Pressing the bearing

Once the part has reached the pressing point a protection screen actuated by a pneumatic cylinder descends to protect the user from any potential incidents. All the safety standards are observed in the equipment; this, in turn, enables user contact with the safety mechanisms used in industry. The pressing cylinder is controlled by a 4/3 way distribution valve as well as it proceeds to lower with adjustable force using a pressure restrictor valve. Once the bearing is pressed, the screen lifts and the product in process is transported to the original position.

As we know, FMS-200 is an equipment or system to illustrate the real FMS in the plant for learning process. In order to apply in the plant, hydraulic press will further discuss in the design methodology with addition other machines as well as AGVs are used for automating material handling after receiving the signal from the workstation. Hydraulic is the powerful supply in order to press or give the high force on a mass of an object. Therefore, hydraulic press is one of the stations that essential in the production line or manufacturing process. The effectiveness of the system will cause the high production rate in the manufacturing process.

DESIGN METHODOLOGY

First of all, the design methodology is started by identifying the elements of block diagram that required for creating the pressing workstation especially for cutting and stamping. Cutting and stamping are the operations that need the force onto the object that can called as pressure. If F is the force acting normal to the surface area A, then pressure P is given by:

$$P = F/A$$

Pressure is defined as the normal force per unit area of a surface in unit Pascal (Pa). In this equation, P stands for pressure while F stands for force and A stands for area. According to the block diagram in Figure 3, it depicts the process of manufacturing is started from the raw material at initial. Then, the insertion raw material will cut into some of pieces by using blade in vertically.

Next, the pieces of raw material will go to the next station for stamping as well as that is the pressing device too. The pressing cylinder is controlled by a 4/3 way distribution valve as well as it proceeds to lower with adjustable force using a pressure restrictor valve. Once the object is pressed, the screen lifts and the product in process is transported to the next station. The operations are also controlled by PLC.

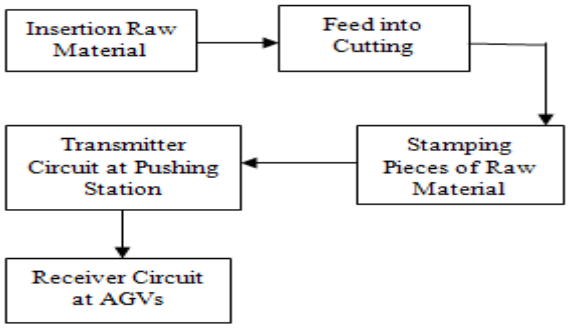

Figure 3: Block Diagram of Manufacturing Process

After the objects reach at the pushing station, the object will detect by motion sensor in order to give the signal for transmitter circuit. After activating the transmitter circuit, the signal will transmit to the receiver circuit at AGVs in order to indicate that the objects need to be taking off to other workstations for completing the product.

In order to illustrate the manufacturing process of workstation in deeply detail as shown in the Figure 4, the design layout can be done by using any graphical software tools which are CATIA, CAD/CAM , RoboSIM and others simulation software.

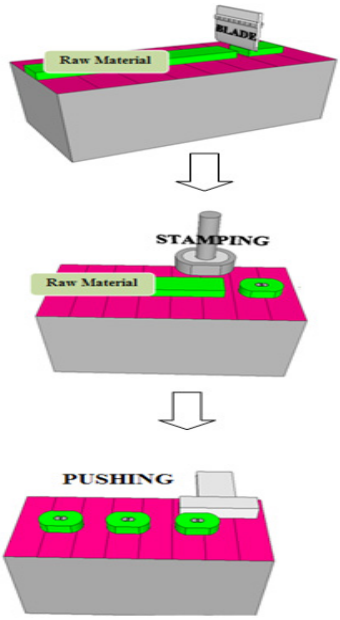

Figure 4: Design Layout of Manufacturing Process

AGVs are the appropriate material handling to substitute human in order to be used in performing the task for loading and unloading the parts between the workstations automatically after receiving the signal at the last station.

CONCLUSION

This paper presents AGVs as an automated material handling in the flexible manufacturing system for substituting human power as well as to achieve a higher performance of FMS in the production line. AGV with signal transmission that consist of transmitter and receiver circuit is the most powerful tool or equipment has been successfully employed to the FMS. A design of FMS especially for pressing workstation has been explained in design methodology. Design layout of workstation has been done using graphical software for illustration understanding.

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R.A.Ramlee
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya, 76100 Durian Tunggal
Melaka
Email: ridza@utem.edu.my

N.M. Jamal, M.M.Ismail,
M.A.Othman, H.A.Sulaiman,
M.H.Misran & M.A.Meor Said
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya, 76100 Durian Tunggal
Melaka

13

Using Recycled Rubber for Road Barrier Structure on Malaysia Highways

Zulkarnain Jamak & Rafidah Abd Karim

ABSTRACT

Highway network built in our country Malaysia has a very good recognition in the Asia region. However, every time when there is a road accident, the particular types of road barriers which caused by the functional W-Beam is often questioned. The accident which is occurs specifically on the impact of the W-Beam is to be a primary factor in order for the researcher to implement a new structural adjustment column. The modification of the pole guardrail structure for road barrier is expected to reduce the level of fatal accidents and serious injuries. The impact of fatal accidents and serious injuries due to collisions and light on the W-Beam effectiveness then will be reviewed by independent testing which use the data obtained. By increasing recycled tires to the structure of road barriers, it can reduce serious injuries on the road drivers. Recycled tires are made of rubber with the necessary elasticity to be used in the road barriers for absorbing impacts attached and it also will reduce the risk of broken barriers and serious injured drivers.

Keywords: recycled tire, road barrier, accident, W-Beam guardrail

INTRODUCTION

Road barrier is an asset to traffic management and in term of safety, barrier provides protection and shielded road users from hazard localize near the edge of travelled way. In fact, road barriers play a major role to sign the driver on a variety of dangers while on the road. Road barriers are used to prevent vehicles from veering off the roadway into oncoming traffic, crashing into solid roadside objects or driving off into ravines [1].

In this era of modern technology, manufacturers, nowadays, were producing various types of road barrier which aims to improve the safety aspect among the road user. Performance requirements for barriers are characterized by containment level, impact severity, and deformation or level of working width. The containment level is the ability of a road barrier to contain and redirect errant vehicles safely for the benefit of the occupants and other road users. For this study, it is focusing on the W-beam guardrail system which designed of these criteria which are specified by the standard EN 1317-5[2].

Road barrier is a feature on a road which is primarily designed to avoid errant vehicle or motorist from having leaving the road and protecting them from hazardous features. These features should be installed where run-off –road accidents are recorded to be high at each location which would result in the reduction of accident severity [8] .

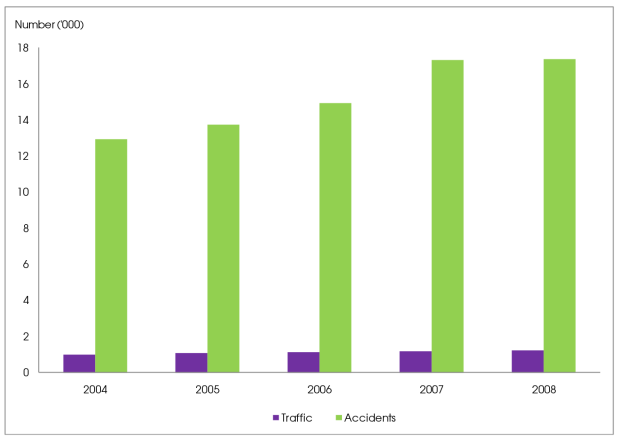
A good design is basically capable to withstand with various types vehicle at different impact condition. Furthermore, the road barrier should deform appropriately upon impact load conditions to minimize risk of injury to other roads occupants. Recently, more researchers have been done in order to upgrade the performance of the road barrier to increase the safety of the vehicle occupant. These include designing and installation with some other significant method which can maximize the effectiveness of the road barrier. This is because the existing guardrails do not give the perfect protection to the vehicle occupants from the impact of collision or accident. Consequently, it increases fatalities and high severe injuries to the vehicle occupant and other road users. To provide appropriate safety levels for impacting vehicle occupants, the safety barriers should be designed in order to fascinate as much high kinetic energy as possible during the crash as well as maintain the reliability. For example, when the vehicle hit the barrier, it will deflect upon impact. Thus, the impact test analysis will be conducted to determine the energy of impact as well as the damage level effect on road barrier.

OVERVIEW OF ROAD ACCIDENTS IN MALAYSIA HIGHWAYS

Road barriers on the highway are among one of the most important elements to guarantee the safety as well as to provide guidance to all users in particular driving on the highway. However, in recent years the issue of highway accidents, especially those involving road barriers often occurred and resulted in serious injury or death. Design, structure, installation, and also the appropriateness of the level of road barrier height are the factors should be reviewed in accordance with the flow of traffic, the type and size of vehicles such as buses, heavy vehicles, four-wheel drive car and motorcycles. Accident on road barriers can also give result in severe injury or death even if it is measured in terms of the technical aspects of the accident that will only involve minor damage on the vehicle but it has occurred otherwise.

Highway provide alternatives route to road users. Until 2008, there were 24 highways operating in Malaysia. Table 1 shows that the traffic volumes have increased to 1,232.6 million in 2008 compared to 1,001.2 million in 2004, an increase of 23.1 per cent. Increased traffic volumes indirectly contributed to the increased number of accidents on the highways. There were a total of 17,369 highway accidents recorded in 2008 compared to 12,949 in 2004, an increase of 34.1 per cent [5].

Table 1: Number of traffic and highway accidents in Malaysia, 2004-2008



As in Figure 1, on June 9, 2011, Malaysian once again awakened by a horrific accident involving a Proton Saga BLM had lost control and crashed into a road barrier, killing four people in Gerik KM 73 Kuala Kangsar Road[5]. The investigation indicates the cause of death was due to a serious injury due to a collision involving semi-permanent road barrier of the type W-Beam as shown in Figure 1. In addition, in October 2010, in the 6.40 p.m. accident, 12 people were killed and about 40 others injured when a northbound express bus crashed through the guardrail and turn over into five vehicles heading in the opposite direction. Therefore, the further study should be implemented to modify the original pillar structure of road barrier and to reduce the level of fatal accidents and serious injuries.

Figure 1: Fatal Accident which four killed in Proton Saga at KM 73 Gerik Road, Malaysia

METHODOLOGY

This quantitative research design of study was using the impact testing experiment. Impact testing methodology is finding the applications for determining the impact strength of different materials. Therefore, this study used the impact test for testing the recycled tires as a material to determine the impact energy and deflection upon impact of guardrail of road barrier.

Data related to road accidents which involve of road barrier on Malaysia highways were reviewed from the secondary data like technical reports, books, newspapers and journal. The type of W-Beam guardrails of road barrier was selected for this experimental study.

Figure 2 shows the scrap tires from the waste area were selected as a material used for increasing the strength of road barrier. The tires have a maximum usage and expiry date. After it could not be used, it was sent to recycling plant.

However, the recycling process will be used high-cost and time. This material was selected in accordance with the use of recycled tires in conjunction with the green technology.

The next step was to sketch the tire recycle structure of W-Beam for road barrier for making structural modifications in order to strentghen the structure of the road barrier as in Figure 3.

Then, the structure of road barrier was newly designed and manufactured based on the sketch as in Figure 3. The recycled tire was placed at the road barrier in order to undergo an impact test for measuring the level of impact that could be used to impact the vehicle on a road barrier.

Figure 2: Scrap tires from the waste area

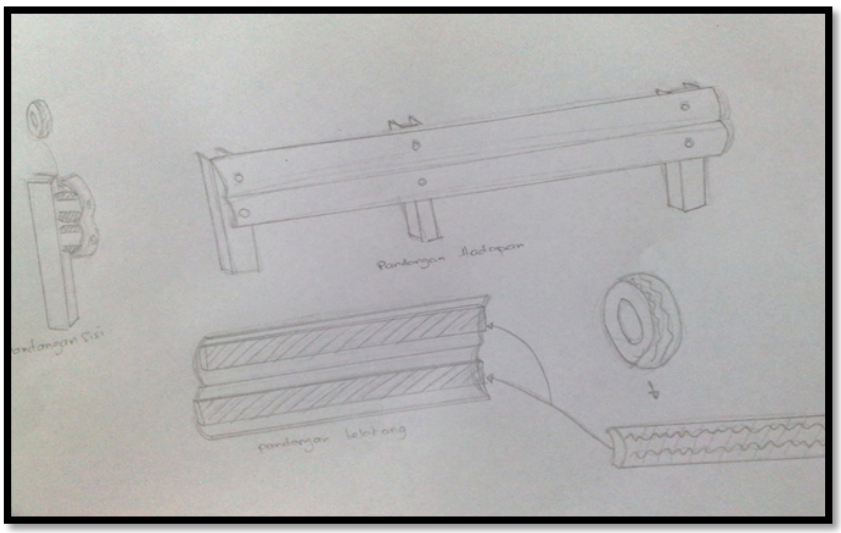


Figure 3: Sketch of Recycled Tire for Strengthening Road Barrier Structure

RESULTS AND DISCUSSION

The experimental study of the impact tests were performed on two different tests which was an impact test without the use of recycled tires and the impact test with the recycled tire. The tests were carried out for three times. Table 2 shows the results of the impact tests which was imposed on the sample of used road barrier in the streets and the road barrier was newly structured by coating a layer rear of tire recycling product.

Table 2: Analysis of Impact Test for Road Barrier

Sample	Force (Lbs/ft)		
	Test 1	Test 2	Test 3
Without Tire	110	110	110
With Tire	180	180	180

From the conducted experimental tests, the study found that if the road barrier use recycled tire as a second layer behind road grates, the force was used to bend bigger iron through the impact test as shown in Table 1. Based on Figure 4, the graph of the impact test from the results of the experimental tests revealed that there was an increasing impact energy which was required if the road barriers were patched with a rubber coating in order to increase the durability of the tire barricades roads from broken or fractured.

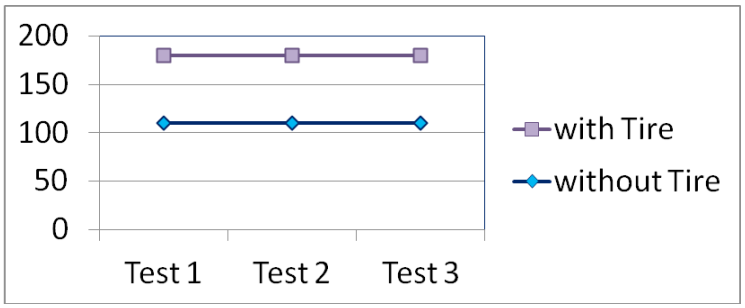


Figure 4: Test Analysis of Impact tests of Road Barrier

CONCLUSION

Based on the innovated and newly structured product that was designed for road barriers and the impact testing experiment that was carried out on the road barrier, it shows there was an increase in energy which was higher by 64%. Thus, the design of this road barrier innovation need more tests to be carried out for future research so that it will ensure the use of coated road barrier with tire rubber is stronger and able to withstand the forces that broke road barrier. In addition to the use of tire recycling layer, it can have an impact on the use of new tire recycling as a green technology contribution in promising the recycling of tires are not left idle and will give full benefit from the contribution to our environment.

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Zulkarnain Bin Jamak
Ungku Omar Polytechnic, Perak, Malaysia
zuljamak@yahoo.com

Rafidah Binti Abd Karim
University Technology of MARA, Perak, Malaysia
feida16@yahoo.com

14

A New Approach of Rock Joint Surface Roughness Characterization for Jointed Rock Mass Classification

Mohd-Nordin M. M. & Mohamed Z.

ABSTRACT

Rock joint surface roughness is a critical parameter for the assessment and classification of jointed rock mass. The conventional Joint Roughness Coefficient (JRC) assessment technique and its limitation resulted to diverse estimation of surface roughness. In this study, the JRC measurement technique was enhanced by introducing a three-dimensional (3D) image-processing approach. The quantitative analysis of surface roughness was accurately measured by peak-to-valley height of the surface profile (P_{max}) for each scan lines. The joint surface scan lines were further analyzed using statistical method. The statistical standard deviation, variance, average surface profile and mean peak-to-valley height of the joint surface profile were interpreted in terms of unevenness and waviness characteristics. Higher statistical parameter values indicate a higher degree of unevenness and waviness of the surface profile thus represented the degree of surface roughness characteristics. Comparatively, as the JRC value increases, the disparity between waviness and unevenness becomes larger. The findings showed that the new approach of rock joint surfaces roughness measurement and analysis has produced a higher accuracy of joint surface characteristic. The accuracy of joint surface roughness measurement shall significant influence the jointed rock mass classification and strength.

Keywords: Joint Roughness Coefficient, Surface Roughness, Rock Joint, Statistical Parameters

INTRODUCTION

Joints in rock masses are formed through natural failures in compression, tension, shear, or some combination of these factors (Bell, 1994). Accordingly, joint surface characteristics are typically described in terms of their hardness, roughness, cementation, filling materials and weathering grade. In fact, the quality of the aforementioned characteristics of rock joint surfaces can have considerable influences on the shear behavior and stability of jointed rock masses (Woo et al., 2010).

The joint roughness coefficient (JRC) introduced by Barton & Choubey (1977) has been widely used to classify the roughness of rock joint surfaces (see Table 1). Several studies had focused on validating and enhancing the JRC classification by improving the JRC measurement and identification techniques. The JRC is typically assessed manually by using a surface profiler which is based on a visual inspection (Beer et al., 2002; Shigui et al., 2009). Recently, it has been possible to precisely estimate the roughness of rock joint surface profiles by using advanced measurement tools that can provide better identification and classification results, such as computer-controlled

surface-scanning devices (Develi & Babadagli, 1998), laser sensor profilometers (Belem et al., 2000), and three-dimensional (3D) laser-scanning profilometer systems (Jiang et al., 2006). The roughness of rock joint surfaces can be classified into two profile characteristics, namely unevenness and waviness (Bell, 1994). These components play different roles in rock joint deformability because of their size, orientation, and elevation or altitude. Waviness is the first-order asperity, and unevenness is the second-order asperity, which closely controls shear behavior. According to Barton and Choubey (1977), the characteristics and features of joint roughness can be explained using verbal descriptions such as smooth, planar, undulating, rough, and irregular.

In this study, an enhancement of rock joint surface characterization was carried out thus improvised the JRC classification assessment. From the 3D image-processing approach, the quantitative analysis of peak-to-valley height of the primary profile (P_{max}) and statistical parameters were introduced from the scan line technique. These analyses comparatively improved the conventional assessment method by manual surface profiler.

Table 1: Description of JRC profile characteristics (Barton & Choubey, 1977) enhanced through P_{max}

Profile	JRC	Description
	0 – 2	Smooth and planar $P_{max} \approx 2.0$ mm
	2 – 4	Smooth and planar $P_{max} \approx 1.5$ mm
	4 – 6	Undulating and planar P_{max}: 1.8 mm
	6 – 8	Rough and planar $P_{max} \approx 3.5$ mm
	8 – 10	Rough and planar $P_{max} \approx 3.8$ mm
	10 – 12	Rough and undulating $P_{max} \approx 6.2$ mm
	12 – 14	Rough and undulating $P_{max} \approx 6.5$ mm
	14 – 16	Rough and undulating $P_{max} \approx 7.0$ mm
	16 – 18	Rough and irregular $P_{max} \approx 6.0$ mm
	18 – 20	Rough and irregular $P_{max} \approx 6.0$ mm
0 cm 5 cm		

CHARACTERIZATION AND CLASSIFICATION OF ROCK JOINT SURFACE

JRC Classification by Surface Profiler

The joint surface samplings from three grades of weathered granite were obtained from breaking the sampling by using the point load test. The nature of the broken surfaces is shown in Figure 3. The classification of the joint surfaces was determined manually by using the conventional surface profiler (Figure 1) and the respective result of JRC values were estimated by visual comparison and summarized in Table 1.

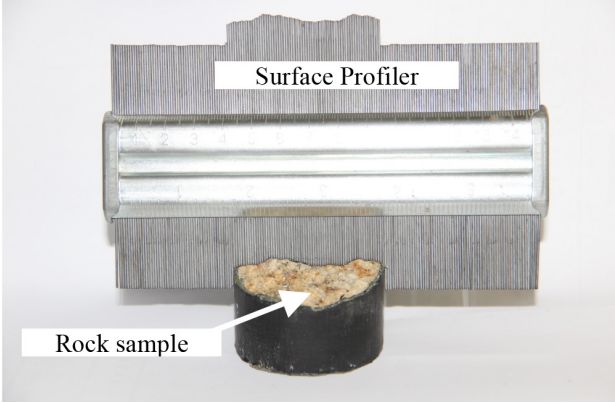
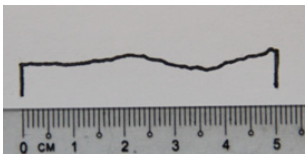
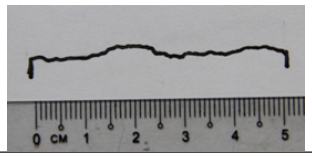
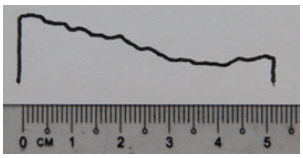
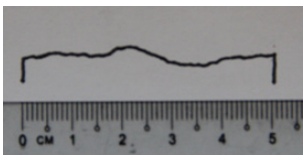
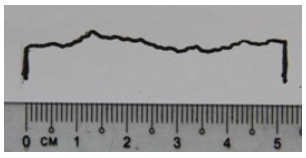
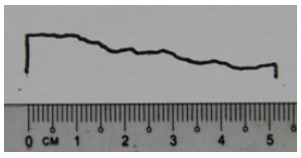
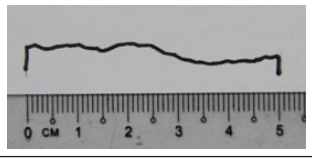
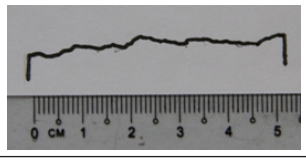
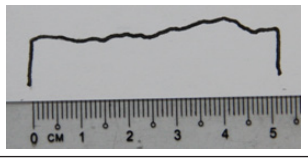
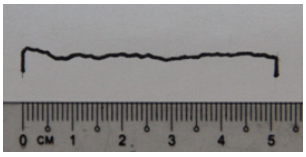
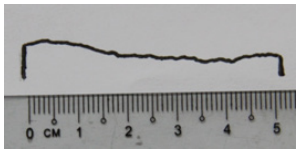
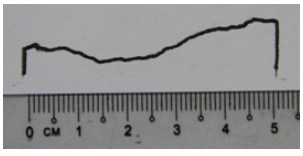
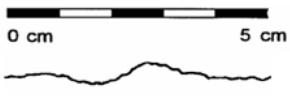


Figure 1: Recording the Rock Joint Surface Profile by Using the Surface Profiler

Table 1: Classification of JRC Values by Manual Surface Profiler

Grade of Weathering	Grade II	Grade III	Grade IV
Profile Measured from Surface Profiler			
			
			
			
Estimated JRC value according to Barton and Choubey (1977)	 JRC = 6 - 8	 JRC = 12 - 14	 JRC = 18 - 20

The profiles resulted from the Grade II surface was similarly comparable to JRC = 6 – 8. This estimation was determined with average results from four degree of undulation profiles. Meanwhile, the estimated JRC value for the surface from Grade III and Grade IV were similarly comparable to JRC = 12 – 14 and JRC = 18 – 20 respectively. The undulation profiles resulted from Grade III joint surface showed wavier undulation profiles compared to Grade II accordingly. While the undulation profiles resulted from Grade IV significantly showed wavier undulation profiles compared to Grade III. The JRC classification by this visual comparison is mostly questionable and in doubted due to the accuracy of identification. Therefore, advance method by 3D digitization technique hence significantly introduced for higher accuracy of characterization and confidence for the JRC classification.

JRC Classification by 3D Image-Processing Approach

For the accurate measurement of rock joint surfaces, surface profiles obtained from 3D digital images of rock joint surfaces were analyzed and characterized. This 3D digitization was performed using Alicona's Infinite Focus (Figure 2), which is an optical 3D surface metrology scanner that widely used for scanning the 3D surfaces.

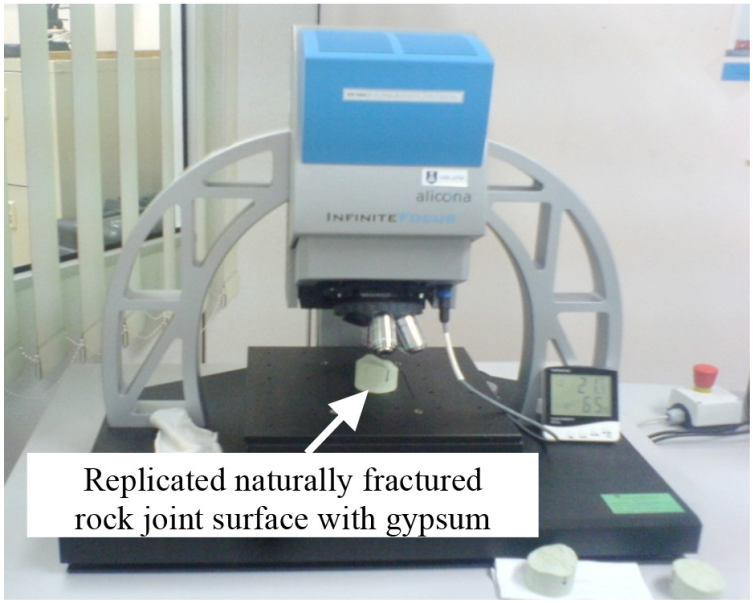


Figure 2: Alicona Infinite Focus® (Optical 3D Surface Metrology Scanner)

Granitic rock samples reflecting three weathering grades were collected from a quarry site in the Klang Valley, Malaysia. Cylindrical samples for each weathering grade were fractured with a point load testing device to form a naturally fractured joint surface. Joint surfaces obtained from fractured rock samples were replicated using gypsum before their profiles were digitized under scanner to measure the JRC values (Figure 3). The resolution of 3D digitized images was set to 2.0 μm. The scanner is equipped with a digital light microscope and has 3D measurement and image analysis capabilities. Surface profiles were obtained from 3D images by using Alicona's Infinite Focus.

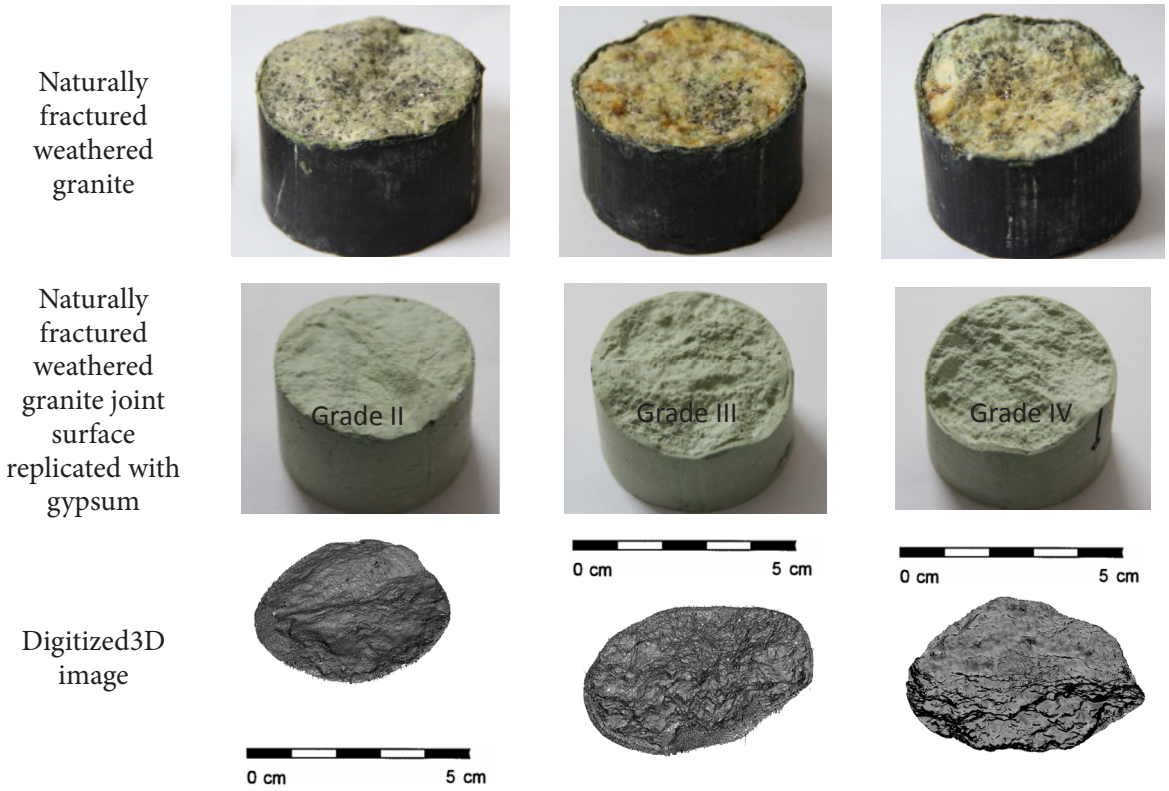


Figure 3: Reproduction of the Joint Surface and 3D Surface Metrology

A set of 2D profiles of a particular surface was extracted from eight scan lines that were 5 cm in length across the 3D surface image. Figure 4 provides an example of these scan lines in a 3D digitized image of a naturally fractured granitic rock joint surface. A surface profile is composed of a wide range of frequency components. High-frequency (or short-wavelength) components correspond to unevenness, whereas low-frequency (or long-wavelength) components correspond to more gradual changes in the profile and are often associated with waviness. The unevenness profile is extracted by filtering long wavelengths out, whereas the waviness profile was extracted by filtering short wavelengths out. Finally, a primary profile of roughness was obtained through a combination of unevenness and waviness components.

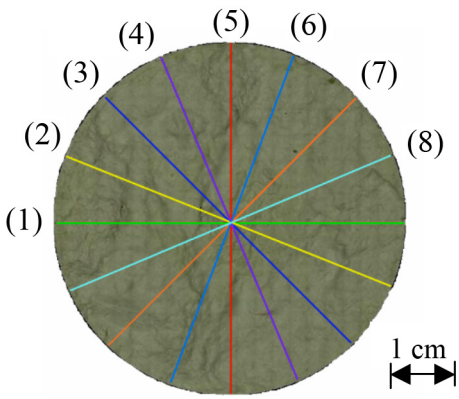


Figure 4: Plan View of Eight Scan Lines on Digitized Joint Surfaces

The captured set of eight primary profiles was compared with the JRC profiles introduced by Barton and Choubey (1977). A quantitative comparison is made based on the peak-to-valley height of the primary profile (P_{max}) (Hotar & Novotny, 2005), and a qualitative comparison was made based on the surface profile description in Table 1. As shown in Figure 5, P_{max} represents the degree of roughness of the primary profile. In general, as P_{max} increases, the JRC value increases.

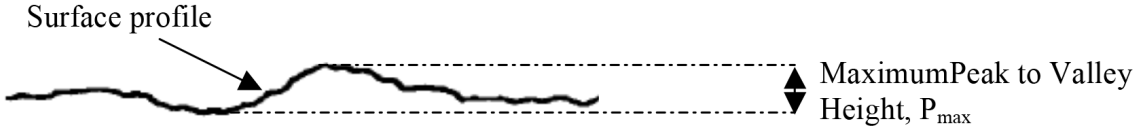


Figure 5: Degree of the Undulation Profile Defined as P_{max}

JRC CLASSIFICATION BY ANALYSIS OF PEAK-TO-VALLEY HEIGHT OF THE PRIMARY PROFILE (P_{MAX})

Joint roughness can be estimated through a combination of quantitative and qualitative considerations. Surface profiles extracted from scan lines can be identified for qualitative assessments based on various descriptions such as smooth, planar, undulating, rough or irregular. In this study, a comparison of the peak-to-valley height between the P_{max} value obtained from surface profiles extracted from 3D images and that obtained from the JRC profiles in Barton and Choubey (1977) was made for a quantitative analysis on a one-to-one scale as summarized in Table 2.

It can be found that weathering grade can be correlated with JRC and P_{max}. Joint surfaces obtained from granitic rocks of weathering grades II, III, and IV were classified into corresponding JRC classes. Based on eight scan lines obtained from the joint surface of the granitic rock of weathering grade II, the primary profile characteristics were identified as rough and planar. Although scan lines 3 and 7 were identified as undulating and planar, rough and planar are identified as the major profile characteristics. The average P_{max} value obtained from the surface profile extracted from the specimen of weathering grade II was 4.3 mm. Therefore, the joint surface for weathering grade II can be correlated with JRC = 6 – 8, with P_{max} of 3.5 mm and profile characteristics are rough and planar.

The joint surface profile characteristics of the granitic rock of weathering grade III were identified as rough and undulating. Although scan lines 6 and 8 were rough and irregular, the most profiles can be characterized as rough and undulating. The average P_{max} value was 6.7 mm. Therefore, the joint surface for weathering grade III used in this paper can be correlated to JRC = 12 – 14, with P_{max} of 6.5 mm and profile characteristics are rough and undulating. The degree of waviness of the joint surface for weathering grade III, which is represented by the profile characteristic and the average P_{max} value, is higher than that for weathering grade II.

Table 2: Summary of results for JRC classification using the scan line technique

Scan line No.	Grade II	Grade III	Grade IV
(1)	P_{max}: 3.8 mm Rough and planar	P_{max}: 8.0 mm Rough and undulating	P_{max}: 11.0 mm Rough and irregular
(2)	P_{max}: 4.0 mm Rough and planar	P_{max}: 7.2 mm Rough and undulating	P_{max}: 10.0 mm Rough and irregular
(3)	P_{max}: 4.2 mm Undulating and planar	P_{max}: 6.4 mm Rough and undulating	P_{max}: 9.0 mm Rough and irregular
(4)	P_{max}: 4.4 mm Rough and planar	P_{max}: 5.8 mm Rough and undulating	P_{max}: 9.0 mm Rough and irregular
(5)	P_{max}: 4.6 mm Rough and planar	P_{max}: 6.2 mm Rough and undulating	P_{max}: 7.0 mm Rough and irregular
(6)	P_{max}: 5.2 mm Rough and planar	P_{max}: 5.8 mm Rough and irregular	P_{max}: 7.0 mm Rough and irregular
(7)	P_{max}: 4.0 mm Undulating and planar	P_{max}: 8.0 mm Rough and undulating	P_{max}: 7.2 mm Rough and undulating
(8)	P_{max}: 4.5 mm Rough and undulating	P_{max}: 6.0 mm Rough and irregular	P_{max}: 9.0 mm Rough and undulating
Average (1) to (8)	P_{max}: 4.3 mm Rough and planar	P_{max}: 6.7 mm Rough and undulating	P_{max}: 8.7 mm Rough and irregular
JRC profile (Barton and Choubey, 1977)	P_{max}: ≈ 3.5 mm Rough and planar JRC = 6 – 8 0 cm 5 cm	P_{max}: ≈ 6.5 mm Rough and undulating JRC = 12 – 14 0 cm 5 cm	P_{max}: ≈ 6.0 mm Rough and irregular JRC = 18 – 20 0 cm 5 cm

The profile characteristics of the granitic rock of weathering grade IV were identified as rough and irregular. Most of the surface profiles were characterized as rough and irregular except for scan lines 7 and 8, which showed rough and undulating profiles. The average P_{max} value obtained from surface profiles extracted from the specimen of weathering grade IV was 8.7 mm. Although the obtained average P_{max} value was higher than the P_{max} value (6.0 mm) for JRC = 18 – 20, the most profile characteristic was identified as irregular, which corresponds to JRC = 18 – 20. Therefore, the joint roughness of the grade IV sample is classified as JRC = 18 – 20.

The results suggest that the weathering grade of the granitic rock governs the roughness of its joint surface. Although the same point load test was conducted to form the joint surface, the higher the weathering grade, the higher the degree of roughness of the joint surface was identified. This is due to the grain size and degree of roughness of the weathered rock joint surface is influenced mainly by the weathering effect (Ehlen, 2002). Therefore, the fracture mechanism of a weathered rock is governed by the intensity of micro-fractures and their geometry within the weathered rock. The intensity of micro-fractures increases as the weathering grade increases from II to IV. The high intensity of micro-fractures can cause a multidirectional failure and thus a rougher breakage surface. The interaction between microfractures has considerable influence on macroscopic faulting (Katz & Reches, 2004).

STATISTICAL PARAMETERS FOR ROUGHNESS OF ROCK JOINT SURFACE

The analysis of statistical parameters for roughness is represented by unevenness and waviness on the weathered granite joint surface profiles which measured by scanning the line around the circular surface of the specimen area. The statistical parameters were represented in order to identify the distribution of elevations for unevenness and waviness on the weathered granite joint surface. Both unevenness and waviness characteristics were analyzed through the statistical parameters known as standard deviation, variance, average surface profile and mean peak-to-valley height. All these statistical parameters were correlated to the class of JRC values.

Standard deviation for unevenness and waviness is represented the dispersion of elevation level on the surface asperity. The higher the standard deviation value represents a higher degree of unevenness and waviness of the profile. As shown in Figure 6, JRC = 6 – 8 shows the lowest value of standard deviation for unevenness followed by JRC = 12 – 14 and JRC = 18 – 20, which is 0.23 mm, 0.35 mm and 0.57 mm respectively. For waviness assessment, the standard deviation values showed similar trend characteristic with standard deviation for unevenness. Hence, JRC = 6 – 8 showed the lowest standard deviation with 0.48 mm, followed by JRC = 12 – 14 and JRC = 18 – 20 with 1.28 mm and 2.68 mm respectively. However, the trend of standard deviation for waviness showed a drastic increment approximately 60 % compared to the standard deviation for roughness.

Standard deviation is defined as the square root of the variance. Therefore, the trend characteristics of variance were similar to the trend characteristics of standard deviation results. As shown in Figure 7, JRC = 6 – 8 showed the lowest value of variance for unevenness followed by JRC = 12 – 14 and JRC = 18 – 20, which is 0.05 mm, 0.12 mm and 0.33 mm respectively. Meanwhile, the variance for waviness showed similar trend characteristic where JRC = 6 – 8 obtained the lowest value by 0.23 mm. The variance of waviness for JRC = 12 – 14 and JRC = 18 – 20 recorded 1.64 mm and 7.20 mm respectively. Therefore, the high value of standard deviation

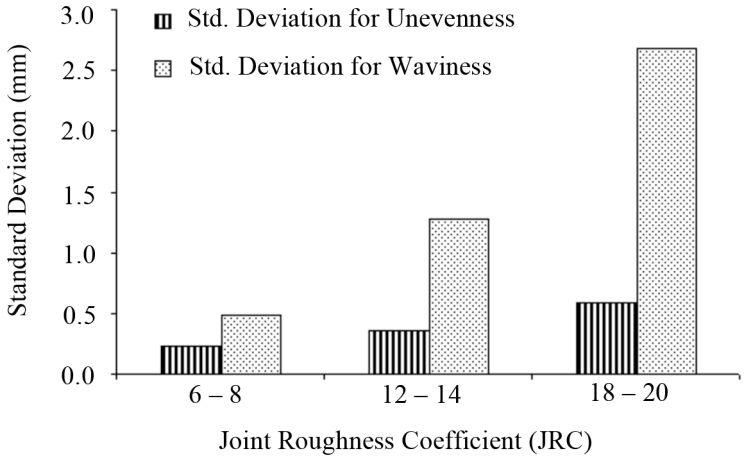


Figure 6: Histogram for Standard Deviation for Unevenness and Waviness with Respect to JRC Values

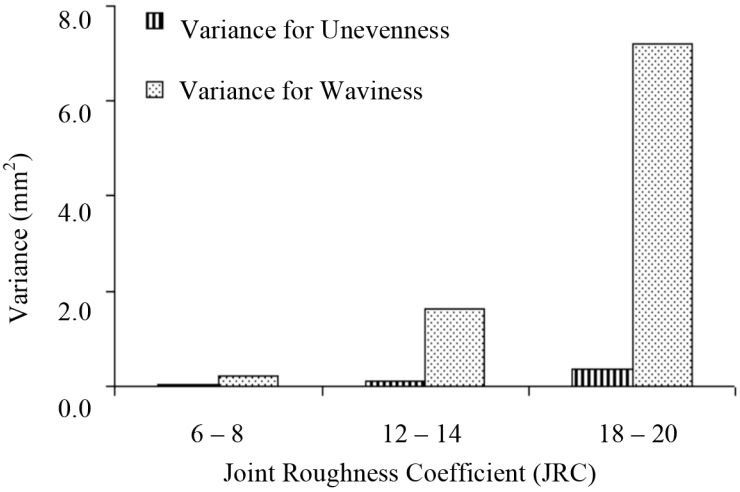


Figure 7: Histogram for Variance for Unevenness and Waviness with Respect to JRC Values

and variance is introduced higher degree of surface unevenness and waviness, which leads to higher degree of frictional behavior between joint surfaces.

The average surface profile for unevenness (U_a) and waviness (W_a) is an integral of the absolute value of the unevenness and waviness profile height over the evaluation length (Hotar and Novotny, 2005). Therefore, profile with the higher value showed a higher degree of unevenness or waviness. As shown in Figure 8, JRC = 6 – 8 recorded the lowest U_a value with 0.16 mm and the greater value was resulted by JRC = 12 – 14 and JRC = 18 – 20 with 0.28 mm and 0.47 mm respectively. The difference of U_a value between each classes of JRC was approximately 50 %. Meanwhile, the trend for W_a characteristic showed the increment of W_a value with respect to the increment of JRC values approximately 40 % and 60 % between JRC = 6 – 8 and JRC = 12 – 14; and JRC = 12 – 14 and JRC = 18 – 20 respectively. JRC = 6 – 8 recorded the lowest W_a with 0.52 mm, while the greater W_a was recorded by JRC = 12 – 14 and JRC = 18 – 20 with 1.20 mm and 2.23 mm respectively. Relatively, the higher value of average surface unevenness and waviness on the joint surface can be identified by the higher of JRC value.

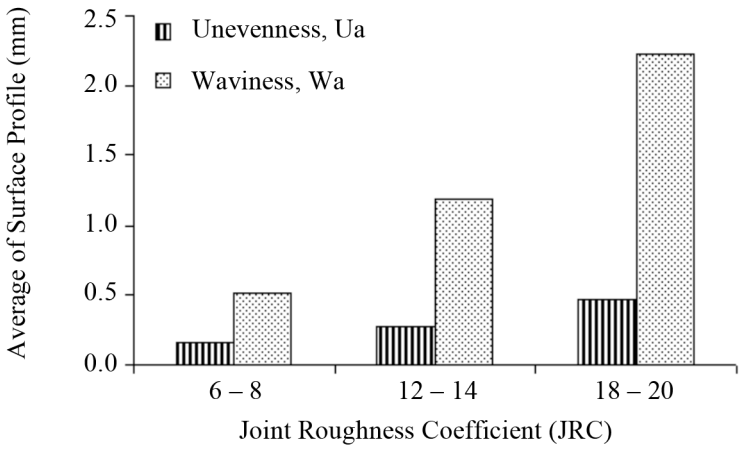


Figure 8: Histogram for Average Surface Profiles for Unevenness and Waviness with Respect to JRC Values

Irregularity and undulation of the surface profile on natural rock joint introduced significant measurement of mean between the peak and valley height which established the unevenness and waviness characteristics. As shown in Figure 9, the statistical parameter of mean peak to valley height for unevenness, U_Z and waviness, W_Z on granite joint surface were recognized as parameters in the quantitative morphological measurement. This surface measurement consequently introduces the degree of frictional behavior from its unevenness and waviness characteristics. JRC = 6 – 8 recorded the lowest value of U_Z by 0.76 mm. The greater U_Z value was recorded by JRC = 12 – 14 and JRC = 18 – 20 with 1.27 mm and 1.85 mm respectively. Similarly, mean peak to valley height for W_Z showed that JRC = 6 – 8 was the lowest by 1.14 mm. The greater W_Z was recorded by JRC = 12 – 14 and JRC = 18 – 20 with 1.99 mm and 4.08 mm respectively.

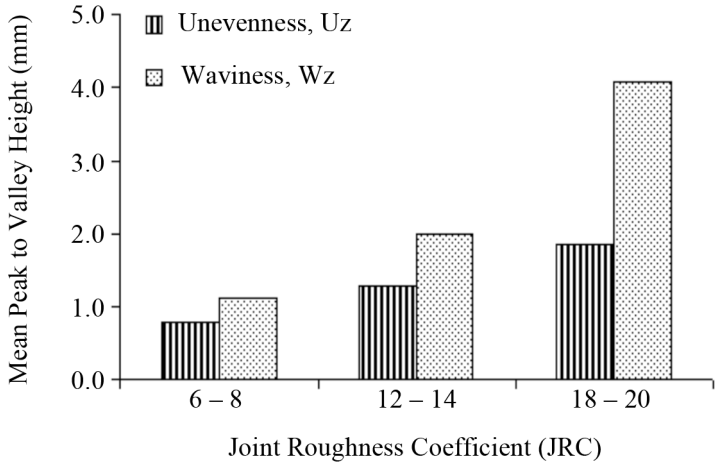


Figure 9: Histogram for Mean Peak to Valley Height for Unevenness and Waviness with Respect to JRC Values

From these statistical quantitative measurements, the roughness surface profile of rock joint was characterized by its unevenness and waviness. Consequently, the higher statistical parameters value represented a more uneven and wavier surface profile, thus indicating a rougher surface.

Meanwhile, as the JRC value increases, the disparity between waviness and unevenness become larger. This finding showed that the characteristic of rock joint surfaces gave significant effect to the jointed rock mass behavior from its mechanical and geometrical characteristics.

CONCLUSION

The enhancement in JRC measurement and classification by introducing the 3D digitization scan lines technique and image processing has resulted to a higher accuracy in JRC classification. The 3D digitized image has significantly provided higher resolution surface profile thus producing higher degree of accuracy for rock joint surface measurement and classification. Meanwhile, the joint surfaces were classified through profile description and maximum peak to valley height (P_{max}) measurement on scan lines. The statistical parameters analysis further quantify the degree of unevenness and waviness of surface roughness characteristics. The findings showed that the new approach of rock joint surfaces roughness measurement and analysis had produced a higher accuracy of joint surface characteristic. The accuracy of joint surface roughness measurement shall significant influence the jointed rock mass classification and strength.

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Mohd-Nordin M. M.*
Mohamed Z.
Institute of Infrastructure Engineering and Sustainable Management,
Faculty of Civil Engineering
Universiti Teknologi MARA Malaysia

**Corresponding Author: Email: mustaqimnordin@ppinang.uitm.edu.my*
Tel No.: +604-382 2634 / +6019-5982087

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Processing Hand-drawn Avatars for Forensics

Cheong Lee Mei & Siti Salmah Yasiran

ABSTRACT

Hand-drawn avatars as online self-representation can be used for criminal investigation in cyber space. These iconic self-representations are important as supporting evidence for other physical evidence in forensic investigation. It is necessary to collect cyber evidence together with general evidence so as to classify documents for effective investigation, including document retention and exchange. This paper identifies hand-drawn avatars as online self-representation which may indicate identity of the user. Informal knowledge about avatars as online self-representation is acquired by considering the broadest possible categories of hand-drawn avatars among 210 participants of ages between 21 and 22 years old with no prior knowledge of readily available online avatars. They were asked to draw a graphical image as a self-representation. A visual inspection of the suitability of a drawn avatar to be scanned into a digital image was conducted. The digital image is scaled to fit the display rectangle. This scaled image can be examined for hidden information. The digital image is then rasterised into a greyscale bitmap. It is easier to locate the object on the image (for the human eye). A filled area plot is conducted for the rasterised image. These operations are displayed through a graphical user interface, called the Avatar4pic. The avatar is subsequently decomposed and reconstructed by using 2D Haar wavelet transformation for storage reduction in a forensic information system.

Keywords: Avatars, hand-drawn avatars, online self-representation, forensics, hidden information.

INTRODUCTION

The affordances of Internet are freedom, democracy, and communication with people around the world. These in turn has generated anxieties concerning the potential of the Internet to corrupt vulnerable minds and facilitates crimes. Online activities such as instant messaging, chats, blogs, and forums often have trails of digital evidence. The process of investigating digital evidence related to an incident under investigation is commonly referred to as Digital Forensic Investigation (DFI). Digital evidence of an incident is any digital data that supports or refutes a hypothesis about the incident (Carrier and Spafford, 2004). The Digital Forensics Research Workshop (DFRWS) model for digital forensic analysis (Palmer, 2001) defines the linear process succinctly:

The use of scientifically derived and proven methods toward the preservation, collection, validation, identification, analysis, interpretation, documentation and presentation of digital evidence derived from digital sources for the purpose of facilitating or furthering the reconstruction of events found to be criminal, or helping unauthorised actions shown to be disruptive to planned operations.

This study is based on the DFRWS model and focused on an empirical collection of hand-drawn avatar. The avatars are scanned into digital images for processing using MATLAB toolbox. This paper is organised as follows. Section 2 reviews the background knowledge and related work. Section 3 describes the collection of hand-drawn avatars while section 4 demonstrates the processing of hand-drawn avatars for forensics. Section 5 shows the conclusion and discussion for further work.

BACKGROUND KNOWLEDGE

Most images are created, stored and distributed in a digital format that is fairly easy to edit and tampered with. A manipulated image is often the result of the application of several tools made available by the image processing software. Consequently, most of the work in digital image forensics thus revolved in proving authencity and integrity of the digital images. Different forensic tools working on different manipulation are employed: single and multiple compression (Farid, 2009, Lukáš and Fridrich, 2003); resampling (Farid, 2009, Mahdian and Saic, 2008) ; cut and paste forgeries (Lin et al., 2009, Luo et al., 2007); and copy and move forgeries (Amerini et al., 2011, Bayram et al., 2008). Each tool provides an output such as image enhancement, image comparison, and image visualisation. The Court will use the output in an easy and convenient way for their interpretation of what happened at the crime scene. Compared to other evidence such as DNA or fingerprints, the question frequently surfaced is whether there has been tampering with the images due to the artefacts that might arise from the forensic image processing. It is hard to employ an image processing method which is not validated before being used in Court.

Besides image processing, pattern recognition in forensics is often used in databases. The image has to searched by Query By Example (QBE) framework for formulating similarity queries over the images (Huijsmans and Smeulders, 1999). In QBE a user formulates a query by providing an example of the object that is similar to the object the user would like to use. The search method involves the acquisition of the image followed by the features extraction from the digitised pattern and stored in the database. A matching algorithm is used in the database. There is a decision of authentication which depends on the amount of similarity.

Four major approaches for pattern recognition are identified (Geradts and Bijhold, 2001) namely, Synactic, Structural, Neural Networks, and Statistical Classifier. In synactic approach, the ridge patterns and minutiae are approximated by a string of primitives whereas in structural approach, the features based on minutiae are extracted and represented using a graph data structure. The matching is done by using the topology of the features. Neural networks approach requires a feature vector to be constructed and classified by a neural network classifier. In statistical classifier approach, statistical classifiers are used instead.

In summary, most image databases are primarily biometry (e.g. DNA, fingerprint, iris, facial features). It is pertinent to note that in crime investigation profiling is made possible through traces in cyber activities such as the use of avatars as online self-representation.

COLLECTION OF EMPIRICAL AVATARS

Informal knowledge about avatars as online self-representation is acquired by considering the broadest possible categories of hand-drawn avatars. 210 participants of ages between 21 and 22 years old with no prior knowledge of readily available online avatars were asked to draw a graphical image as a self-representation for online use. A visual inspection of the suitability of a drawn avatar to be scanned into a digital image was conducted. They were given a piece of A5 paper and a pencil to draw their an avatar each. The avatars were inspected for suitability to be scanned and stored as jpeg images. Additional information pertaining to gendering and motivation of the avatars were explored and published in an earlier paper (Cheong and Fariza,2012). The hand-drawn avatars were processed using the MATLAB Toolbox.

PROCESSING HAND-DRAWN AVATAR

Each of the hand-drawn avatars is stored as jpeg images with an ID in a database. The images can be easily retrieved with the following codes in C++.

```
[filename,pathname] = uigetfile('*.jpg','Select an Image');
image1 = imread([pathname,filename]);
axes(handles.axes1);
imshow(image1);
```

A graphical user interface called Avatar4pic is designed through MATLAB.

Hiding information

Figure 1 depicts four images (clockwise from top left): digital avatar; intensified avatar to fit a given rectangle; a greyscale bitmap of the avatar; and a filled area plot for the avatar.

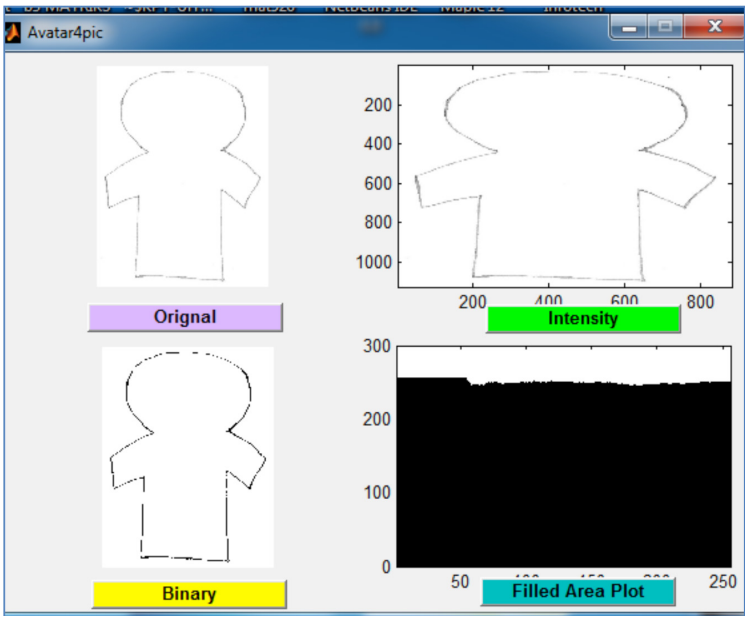

Figure 1: Image1 in Avatar4pic

The digital avatar is scaled to fit the display rectangle as shown.

```
image1=handles.image1;
axes(handles.axes2);
imagesc(image1);
%Each element of image1 corresponds to a rectangular area in the image
handles.image1 = image1;
guidata(hObject,handles);
```

This scaled image can be examined for hidden information, if any. The digital image is then rasterised into a greyscale bitmap. A greyscale image contains only pixels of two intensity values, one for background pixels and one for object pixels, the contrast of the object would be the difference of those values. It is easier to locate the object on the image (for the human eye). The following is a code snippet for the rasterisation.

```
imageB=handles.image1;
axes(handles.axes2);
level =graythresh(imageB);
imageA =im2bw(imageB,level);
axes(handles.axes3);
imshow(imageA);
handles.imageA = imageA;
guidata(hObject,handles);
```

A filled area plot is then conducted for the rasterised image as shown by the code snippet.

```
b=handles.imageA;
axes(handles.axes4);
area(b(1:256,1:256),'DisplayName',"b(1:256,1:256)');figure(gcf);
```

It is an area graph that displays elements in Y as one or more curves and fills the area beneath each curve. When Y is a matrix, the curves are stacked showing the relative contribution of each row element to the total height of the curve at each x interval.

Figure 2 shows the avatar Image2. Additional details were added on the original Image1. Note there is hardly any difference in the filled area plot. The additional inforamtion were not captured in the filled area plot. The artefacts of image processing were notable in the original and binary images .

Storing avatars

It is pertinent to store information of acceptable quality from an image. Wavelets contribute to effective solutions for this problem. Wavelets are a set of non-linear bases. Unlike families of linear bases which use static set of basis functions for every input function, wavelets employ a dynamic set of basis functions that represents the input function in the most efficient way. The

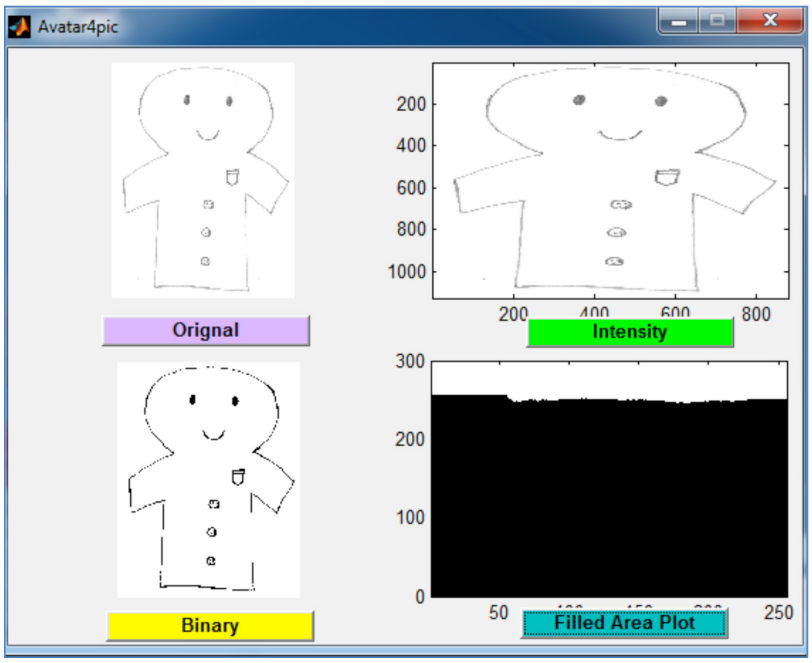

Figure 2: Image2 with additional information

wavelet basis functions are chosen according to the function being approximated. Thus wavelets are able to provide a great deal of compression in image processing.

The goal of true compression is to minimize the number of bits needed to represent it. The Haar transform is the simplest orthogonal wavelet transform. It is computed by iterating difference and averaging between odd and even samples of the signal. Since the avatar is in 2-D, the computational is only required for the average and difference in the horizontal, diagonal and vertical direction. To transform the input matrix, the 1D Haar transform is applied on each row. With the resultant matrix, the 1D Haar transform is applied on each column. This gives the final transformed matrix.

```
void haar1(float *vec, int n, int w)
{
    int i=0;
    float *vecp = new float[n];
    for(i=0;i<n;i++)
        vecp[i] = 0;
        w/=2;
        for(i=0;i<w;i++)
        {
                vecp[i] = (vec[2*i] + vec[2*i+1])/sqrt(2.0);
                vecp[i+w] = (vec[2*i] - vec[2*i+1])/sqrt(2.0);
        }
        for(i=0;i<(w*2);i++)
                vec[i] = vecp[i];
        delete [] vecp;
}
```

The algorithm takes the sums and differences of every pair of numbers in the input vector and divides them by square root of 2. The process is repeated on the resultant vector of the summed terms. The 2D Haar transform is used extensively in image compression. The following shows the code snippet.

```
void haar2(float **matrix, int rows, int cols)
{
    float *temp_row = new float[cols];
    float *temp_col = new float[rows];
    int i=0,j=0;
    int w = cols, h=rows;
    while(w>1 || h>1)
    {
        if(w>1)
        {
                for(i=0;i<h;i++)
                {
                        for(j=0;j<cols;j++)
                                temp_row[j] = matrix[i][j];

                        haar1(temp_row,cols,w);

                        for(j=0;j<cols;j++)
                                matrix[i][j] = temp_row[j];
                }
        }

        if(h>1)
        {
                for(i=0;i<w;i++)
                {
                        for(j=0;j<rows;j++)
                                temp_col[j] = matrix[j][i];
                        haar1(temp_col, rows, h);
                        for(j=0;j<rows;j++)
                                matrix[j][i] = temp_col[j];
                }
        }

        if(w>1)
                w/=2;
        if(h>1)
                h/=2;
    }

    delete [] temp_row;
    delete [] temp_col;
}
```

Figure 3 shows another avatar, Image3, in Avatar4pic. The 2D Haar transformation will be used to compressed Image3.

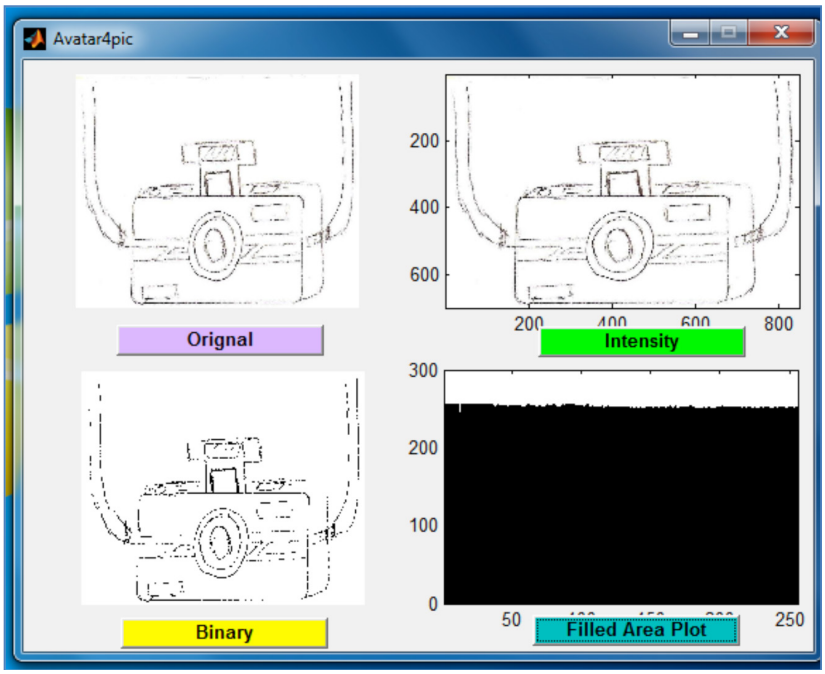

Figure 3: Image3 in Avatar4pic

Figure 4 shows the decomposition (dwt) of image3 to three levels, the reconstruction (idwt) as in the synthesized image, and the approximation at level 3. It can shown that the approximation is a much better image than the original.

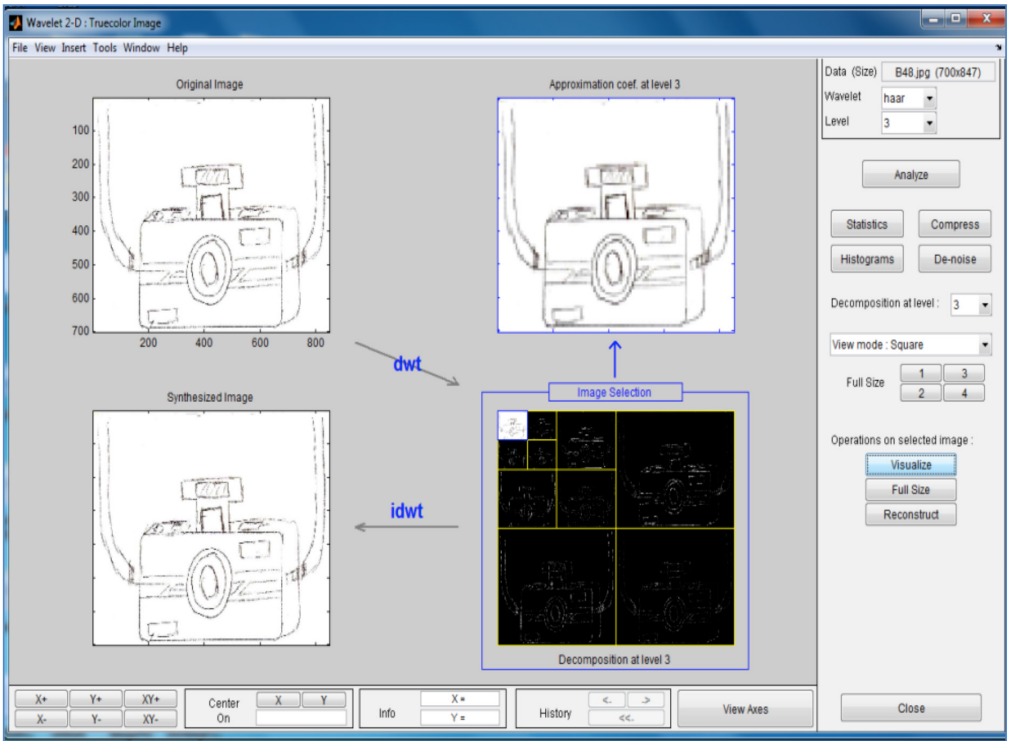

Figure 4: Decomposition and Reconstruction of Image3

Figure 5 shows the 2D Haar transformation of Image3 in three iterations with a tree view mode. There are four images in a wavelet transformation. The image on the left of each level has most of the energy conserved. Thus it is an approximation of the entire image.

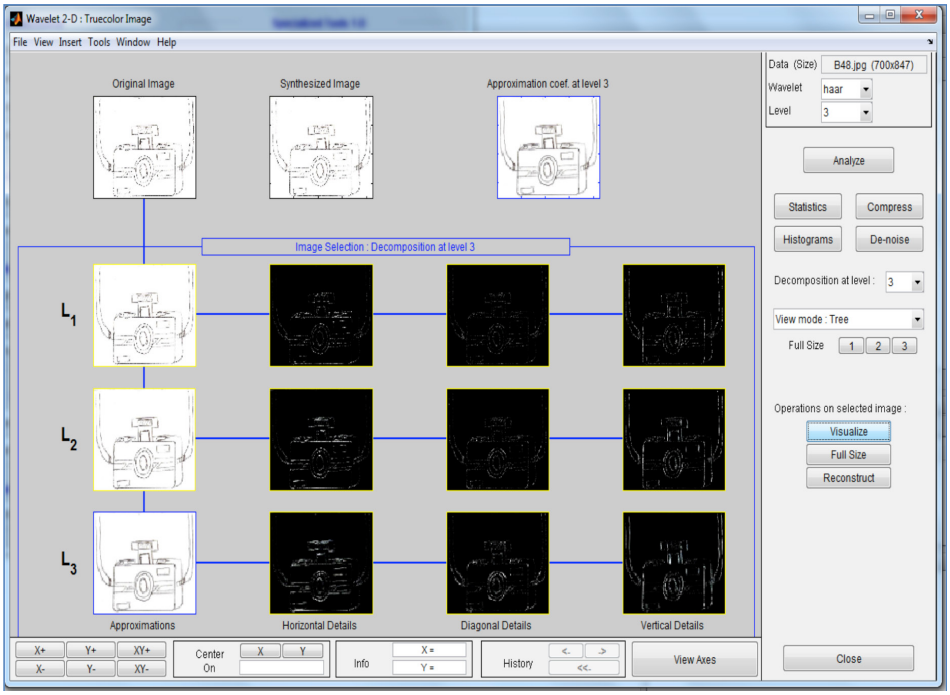

Figure 5: 2D Haar transformation of Image3 with 3 iterations

The remaining three images show the differences in the vertical, diagonal, and horizontal directions, respectively. The three images consist primarily of values that are zero or near zero. Image3 is stored in matrix with dimensions 700 x 847 pixels. The horizontal details hold information about horizontal in the image. A large values indicate a large horizontal change as we move down the image and small values indicate little horizontal change. Similarly, the vertical details hold information about vertical in the image. The diagonal details contain differences across both columns and rows. It measures changes along 45-degree lines.

The 2D Haar transform is iterated three times where there is not much change in the image. The image can be effectively coded and the storage space for the image can be drastically reduced.

Figure 6 shows the energy distribution for the original image (global threshold) and three iterations of the 2D Haar transform (pink). The horizontal scale is pixels. For a given pixel value p, the height represents the percentage of energy stored in the largest p pixels of the image. Note that the iterated 2D Haar transform gets to 100% of the energy much faster than the original image.

DISCUSSION AND CONCLUSION

The hand-drawn avatars were visually checked for suitability to be scanned into digital images. The digital image is then rasterised into a bitmap for plotting as a filled area. The filled area plot of an image is similar to the embellished form of it. The embellishment can be a form for hiding

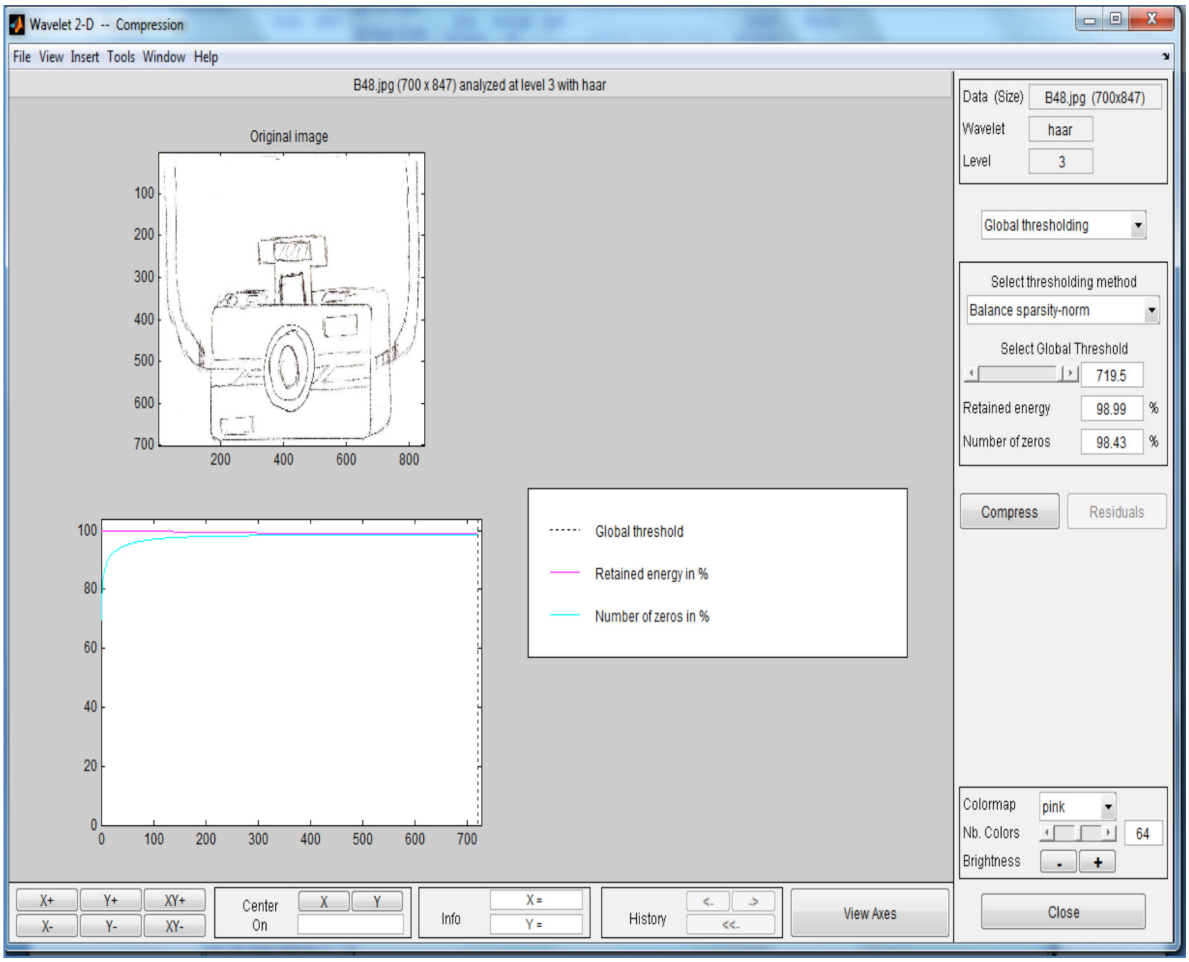

Figure 6: Energy distribution of Image3

information which serves as intangible evidence in forensics. Intangible evidence is non-specific and non-provable but derived from wider analysis. It provides an understanding of the motives, relationship and actions of a suspect rather then provide evidence per se. Hidden information can take many forms, such as coded text, icons, lines, and geometric figures. This aspect requires further exploration.

Despite being cropped to remove the surrounding white spaces, some of the images were too large to fit into the predetermined size of the filled area plot. This infers that the bitmaps of avatars is too demanding on the storage space of a forensic information system. To circumvent the problem, the alternative is to decompose and reconstruct an avatar in bitmap using the iterated 2D Haar wavelet transformation. Thus the image is coded and the storage of it is very much reduced as shown by the energy distribution.

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Cheong Lee Mei
Institute of Forensic Science
Faculty of Computer and Mathematical Sciences
Universiti Teknologi MARA Malaysia
Email: dianne@salam.uitm.edu.my

Siti Salmah Yasiran
Faculty of Computer and Mathematical Sciences
Universiti Teknologi MARA Malaysia
Email: salmahyasiran@salam.uitm.edu.my

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The Quality Changes of Orthosiphon Stamineus Leaves During Short Storage Treatments

Norawanis Abdul Razak, Abd Razak Shaari & Ibni Hajar Rukunuddin

ABSTRACT

Temperature of the storage may affect the changes of total phenolic content (TPC) and total antioxidant activity (TAA) of *Orthosiphon stamineus* dried leaves during short storage. Three different storage temperatures; low temperature (TL=10°C in average at daylight and night), medium temperature (TM=25°C in average at daylight and night) and high temperature (TH= 38°C in average at daylight and 25°C in average at night); were selected to investigate the changes of TPC and TAA. All samples were stored less than 6 months. From the results, the initial values of TPC and TAA at 0 day of storage were 58.38 ± 2.3 μg/g and 79.59 ± 0.2 %. The mean value of TAA declined slightly in 45 days and slightly upward for the next two points, days of 90 and 135. Otherwise, TPC values shown significant differences by time of storage. At the days of 90, the mean value for each storage treatment rose sharply compared the others day. Some chemical reaction might be happened during storage at this time and inadvertently raise the quantity of TPC. In other correlation, the mean value of TPC not affected by the mean value of TAA in this dried leaves. The results of this research are useful for entrepreneurs especially who are involved in nutraceutical and food functional industry. The quality of the finish product should be maintained as high as a quality in a fresh raw material even through a long process.

Keywords: Post-harvest; Stored plant; Total phenolic content; Total antioxidant activity; Medicinal plant; Misai Kucing plant.

ABSTRAK

Suhu ruang penyimpanan boleh menjejaskan perubahan jumlah kandungan fenol (TPC) dan jumlah aktiviti antioksidan (TAA) di dalam daun Orthosiphon stamineus yang dikering semasa penyimpanan masa singkat. Tiga suhu penyimpanan yang berbeza telah dipilih, iaitu suhu rendah (TL = 10 ° C; bacaan suhu dalam purata pada siang dan malam), suhu sederhana (TM = 25 ° C; bacaan suhu dalam purata pada siang dan malam) dan suhu tinggi (TH = 38 ° C; bacaan suhu dalam purata pada siang dan 25 ° C; bacaan suhu purata pada waktu malam); untuk mengkaji perubahan TPC dan TAA. Semua sampel disimpan selama kurang daripada 6 bulan. Daripada keputusan yang diperoleh, nilai bacaan awal TPC dan TAA pada 0 hari adalah 58.38 ± 2.3 μg / g dan 79,59 ± 0.2%. Nilai purata TAA merosot sedikit pada hari ke-45 dan sedikit peningkatan berlaku pada dua bacaan seterusnya, iaitu hari ke-90 dan 135. Bertentangan pula dengan nilai TPC, ia menunjukkan perbezaan yang ketara semasa proses penyimpanan. Pada hari ke-90, nilai purata bagi setiap penyimpanan meningkat dengan mendadak berbanding hari yang lain. Tindak balas kimia mungkin berlaku semasa proses penyimpanan pada ketika itu dan tidak langsung meningkatkan kuantiti TPC. Selain itu, daripada kajian ini didapati bahawa nilai purata TPC tidak terjejas oleh perubahan nilai purata TAA. Hasil kajian ini pasti berguna bagi para usahawan terutamanya yang terlibat dalam industri nutraseutikal

dan makanan. Kualiti produk akhir yang bakal dipasarkan perlu dijaga kualitinya seperti kualiti asal semasa di ladang walaupun ianya terpaksa melalui proses yang panjang.

Kata kunci: Penuaian; penyimpanan tumbuhan; jumlah kandungan fenolik; jumlah aktiviti antioksida; tumbuhan ubatan; pokok Misai Kucing

INTRODUCTION

In agriculture, post-harvest is a process applied immediately after plant matured enough and ready to be processed. The main element of post-harvest process based on FAO cooperate document repository, included harvesting, pre-harvest drying, transport, post-harvest drying, threshing, storage, processing and marketing. Every single step will cause deterioration of quality if taken for granted. Therefore, a variety of research has been done to solve this issue with a view to help farmers by supplying the correct procedure to prevent further quality loss.

Commonly, the plant will be sold in two conditions that in a fresh product or processed product. For fresh product, there is no issue will be raised by consumer because they can judge the quality of the product by its appearance themselves. Contrary to processed product, the consumer cannot assess the quality of the product by their gross view except by refer the information printed on the packaging of the product. Furthermore, most of the processed product is processed in dried form to prolong its shelf life (Lin et. al., 2011; Oladele and Aborisade, 2009; Kozukue, 2009). Before being processed to final product, typically dried material will be stored for a while in a room or clean place. However, it has been approved by previous research that deterioration happened during storage. Among the factors that influences is temperature, humidity, light intensity and microbial load (Sun et.al., 2012; Korus, 2011; Oladele and Aborisade, 2009; Tan et. al., 2008; Taylor et.al., 2001).

Orthosiphon Stamineus is nutrient-rich plant and grown widely in tropical area included Malaysia, Thailand, Indonesia, Philippines and Brunei (Mardi, 2005). The species are distinguished by its color of flower that is white and purple (Mardi, 2005). The physical appearance of the flower look like a cat whisker and commonly it is also named as 'Misai Kucing' (Mardi, 2005). It is labeled as medicinal plant according to its secondary metabolites such as rosmarinic acid (Sriyana et. al., 2012; Akowuah et.al., 2005), eupatorin (Akowuah et.al., 2005), sinensetin(Sriyana et. al., 2012; Akowuah et.al., 2005; Schut and Zwaving, 1993) and 3'-hydroxy-5,6,7,4'-tetramethoxyflavone (Akowuah et.al., 2005; Schut and Zwaving, 1993).It is believed can treat chronic diseases such as diabetes, hypertension, gout, kidney stones and urinary tract infection(Mardi, 2005; Akowuah et.al., 2004). It is also can be applied as cancer's bidder (Mardi, 2005; Akowuah et.al., 2004; Sumaryono et. al., 1991).

As a great functional food, *Orthosiphon Stamineus* is utilized widely in nutraceutical and functional food industry. There are a lot of market products sold to consumer based on this plant. Its ability to heal and reduce pain has attracted consumer to apply it daily as a remedy or supplement. However, its effectiveness as a healer may be affected after going through several processes before being marketed (Malcata et. al., 2013). This issue has attracted us to study the effect of temperature on the changes of total phenolic content and total antioxidant activity of this plant during short time storage. At the end of this study, we hope that our results can be a

good reference especially to entrepreneurs to maintain the finish product quality and indirectly able to achieve consumer desired.

MATERIALS AND METHODS

Orthosiphon Stamineus plantation

A plot of plants was grown at Universiti Malaysia Perlis (UniMAP), Campus Sungai Chuchuh, Padang Besar, Perlis. Planting technique was done according to the technique suggested by MARDI (2005). Plant propagation by stem cutting was applied. Distance between plants was set up about 30 cm in a row and distance between rows was approximately 150 cm. Chicken manure and compound NPK=10:10:10 were utilized as a fertilizer. The first crop collection was done after 10 weeks of planting.

Drying and sorting of plant

After harvest, the plants were washed in clean water. A small bundle of fresh plants was tied neatly and hanged in a row with same distance. The drying process was done under shed for 7 days. After that, the dried leaves, stems and flowers were sorted carefully. Only dried leaves were used in this study.

Storage treatment

The samples were packed individually ±10g in sealed polyethylene bags. The samples were prepared in triplicate. Three different temperatures were used as a storage treatment in this study. They were selected based on current scenario might be applied in most of herbal manufacture industry. The selected temperatures were labeled as below **(Table 2.1)** and they are prepared in triplicate. The consistency of temperatures was observed using temperature data logger (Extech, USA).

Table 2.1 Storage treatment description.

Treatment	Average temperature °C (daylight)	Average temperature °C (night)
Low Temperature (TL)	10	10
Medium Temperature (TM)	25	25
High Temperature (TH)	38	25

All samples were divided randomly into each storage treatment. They were kept in dark boxes to prevent light entry. Every 45 days, three samples were taken out randomly from each box for analysis.

Extraction of sample

Approximately ±1gram of dried leaves were weighed using electronic balance (Shimadzu, Japan). 100ml of distilled water was used as a solvent for each sample. They were mixed together

in a conical flask. Water bath with shaker was used to extract the samples. The extraction was conducted for 3 hours in 40°C water bath temperature and shaking at 200 revolutions per minute (rpm). After extraction completed, each solution was filtered using filter paper (Whatman No.1) and was kept in a sealed bottle. The extract solutions were stored in a freezer (-20°C) for next analysis.

Total phenolic content (TPC) analysis

In a dark room condition, 200µl of Follin-Ciocalteu reagent (FCR) and 200µl was mixed to 1.58 ml distilled water. After 4 minutes, 1 ml sodium carbonate was mixed together. The mixer was allowed to react for 2 hours in a dark place. After 2 hours, the absorbance was calculated using Shimadzu spectrophotometer (λ=760nm) and reading was recorded.

Total antioxidant activity (TAA) analysis

2,2-diphenyl-1-picrylhydrazyl (DPPH) was used as free radical to count the total antioxidant capacity. About 2 ml of DPPH was mixed with 200 µl sample. Then methanol was used to mark up the mixture to 3 ml. The mixture was allowed to react in a room temperature for 1 hour. The control also prepared. After 1 hour, the absorbance value was calculated using Shimadzu spectrophotometer (λ=512nm) and reading was recorded.

$$\% \text{ Antioxidant capacity} = [(\text{Abs control} - \text{Abs sample})/\text{Abs control}] \times 100\%$$

*Abs = absorbance

Data and statistical analysis

All data were analyzed using Excel application and JMP software.

RESULT AND DISCUSSION

In this study, only part of leaves were used to analyze the quality effectiveness of *Orthosiphon Stamineus* based on two selected parameters that were total phenolic content (via Follin-Ciocalteu method) and total antioxidant activity (via DPPH method). All the leaves were dried to approximately ±14% of moisture content before they were stored under different treatments. The moisture content which might be obtained during storage treatment was negligible. The boxes and the sealed polyethylene bags that were used to keep the samples were considered as a barrier to the external others factor such as light, oxygen and microorganism that might affect the quality of samples. The temperature levels were selected based on the look-like temperatures which commonly utilized in either small industry or large industry in Malaysia.

Table 1 shows the mean values of total phenolic content (TPC) and total antioxidant activity (TAA). Each of them was represented in unit of µg/g and percentage (%). The initial values of TPC and TAA at 0 day of storage were 58.38±2.3 µg/g and 79.59±0.2%. All samples were considered same at initial values and they were selected randomly after packed individually about ±10g in polyethylene bags.

Table 3.1 Changes in total phenolic content (TPC) and total antioxidant activity (TAA) in different storage treatments; low temperature (TL), medium temperature (TM) and high temperature (TH).

TEMPERATURE	DAY(S)	0	45	90	135
TL	TPC	58.38±2.3	45.83±1.21	173.57±5.44	72.68±2.58
	TAA	79.59±0.2	72.93±1.02	77.92±1.53	77.72±1.32
TM	TPC	58.38±2.3	54.58±1.71	196.38±4.56	87.97±3.56
	TAA	79.59±0.2	74.28±0.76	83.07±0.94	82.67±1.37
TH	TPC	58.38±2.3	56.68±1.67	199.61±9.77	96.50±2.94
	TAA	79.59±0.2	77.93±0.79	81.93±0.65	84.76±0.42

Note: Mean value ± Standard error (n=9)

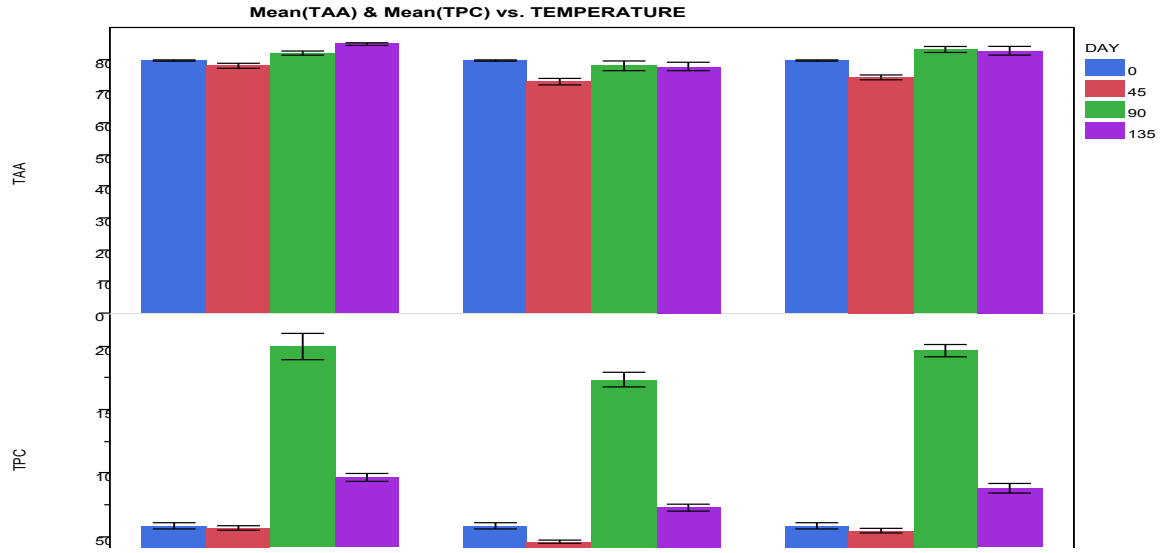

Figure 3.1 Relationship between total phenolic content (TPC), total antioxidant activity (TAA), temperature and storage duration. The total samples equal to 9 (n=9).

A clear illustration could be seen by observing **Figure 1**. A little changes of TAA clearly visible on the figure against time of storage for every storage treatment. The mean value of TAA declined slightly in 45 days and slightly upward for the next two points, days of 90 and 135. The pattern of the changes was not so different for all storage treatments. Otherwise, TPC values shown significant differences by time of storage. At the days of 90, the mean value for each storage treatment rose sharply compared the others day. Some chemical reaction might be happened during storage at this time and inadvertently raise the quantity of TPC. This reaction was supported by Padda and Picha (2008) study on TPC of sweet potatoes. They reported that there was an accelerated buildup of TPC during storage of sweet potatoes. Watada and Moris (1966) claimed that the metabolism of intermediates accumulated occurred during chilling.

According to storage treatments, statistically the results exhibited no significant ($p>0.05$) between three temperatures. This results not have enough evidence to support the fact that a lower of temperature could prolong the shelf life and protect the quality of the dried material (Karunakaran et. Al., 2001).

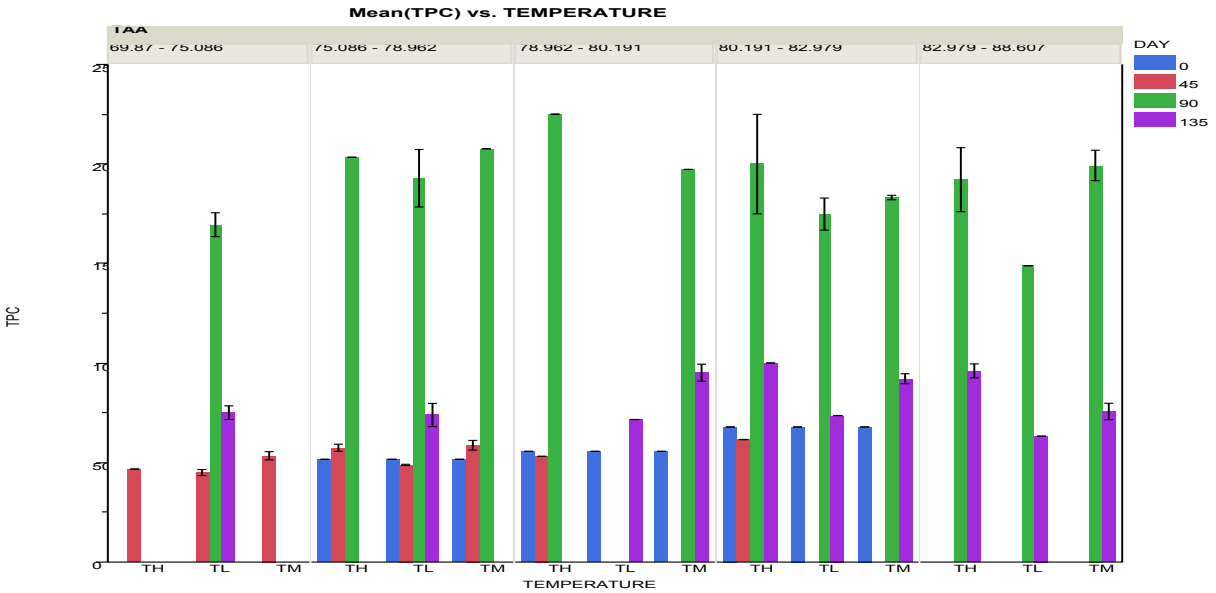

Figure 3.2 Distribution of total phenolic content (TPC) values in a range of total antioxidant activity (TAA).

According to **Figure 2**, the results of distribution based on TAA range proved that the changes of the TPC were not influenced by TAA. Even though the value of antioxidant was high, it was not indicate the value of TPC also high. This was likely to indicate that the content of antioxidant compound was not affected by the changes of temperature. Conversely, the different of temperature might be the one of the factor which influenced the changes of other phenolic content which were not acted as antioxidant in human body.

CONCLUSION

Firstly, from this study we concluded that the selected of storage treatment in low temperature (TL=10°C in average at daylight and night), medium temperature (TM=25°C in average at daylight and night) and high temperature (TH= 38°C in average at daylight and 25°C in average at night) were not giving large impact to the changes of total phenolic content (TPC) and total antioxidant activity (TAA) in *Orthosiphon Stamineus* dried leaves during short storage. Thus, the entrepreneurs were suggested to keep their dried materials in room temperature (25°C) because this way can reduce the cost of electricity and cost of production. However, the time of storage should be considered too to prevent the loss of quality during storage. The second conclusion, this study exhibited that the changes of TPC and TAA not related to each other as long as the dried materials were kept less than 6 months. This study will be continued for the next stage. The time of storage will be extended to investigate the changes of TPC and TAA in *Orthosiphon Stamineus* dried leaves.

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Norawanis Abdul Razak*
Abd Razak Shaari
Ibni Hajar Rukunuddin
School of Bioprocess Engineering,
University Malaysia Perlis,
02600 Arau, Perlis, Malaysia.

**Corresponding author. Tel.: 019-5474852*
E-mail address : norawanisabdulrazak@yahoo.com

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User-centered Design Makes Teaching Materials Usable

Ariffin Abdul Mutalib

ABSTRACT

This paper presents a part of an ongoing study on incorporating the Multiple Intelligence into learning materials for children. This study believes that incorporating the Multiple Intelligence theory into learning materials is able to add more values towards the usability aspects of learning materials. In accordance, this paper aims at describing an attempt in designing a learning material that incorporates the Multiple Intelligence. In particular, the aims of the paper are (1) to suggest on how the elements of Multiple Intelligence could be incorporated into learning materials and (2) to outline the design and development of a sample of learning material that incorporates the Multiple Intelligence. User-centered design (UCD) approach is used as part of the methods in the design process, which involves three stages: (1) requirement gathering, (2) prototype development, and (3) user testing. This study involves children and teachers at kindergartens. As the results, an initial design of the learning material that incorporates the Multiple Intelligence is obtained and discussed in this paper at length.

Keywords: Electronic teaching material; multiple intelligence; user-centered design, EliteKids

INTRODUCTION

This study is proposed to assist teachers at pre-schools in their teaching and learning activities. In relation, children are exposed to technologies at home, so when they are in school, they are more attracted to technology-enhanced learning activities (Halimah, Norhayati, Nor Azan, Tengku Mohd, Mohamad Yusoff, & Munir, 2000). This requires pre-schools to provide eLM for their teachers in suppports of children's needs (Jones & Jo, 1998). Inline with that, many eLM in the form of courseware are available in the market, and some of them come with textbooks. However, the courseware is developed without studying the needs of teaching and instructional strategies. It can also be observed that children use the courseware on their own (Elsom-Cook, 2001), which in a way supports active learning (Faridah Hanim & Halimah, 2008). Unfortunately, the roles of teacher in this type of courseware are less, because the courseware are developed for students' self-paced learning (Regan & Sheppard, 1996).

There is a need for supporting teaching and learning in classroom, beyond the self-paced approach. The teaching materials should include various activities, as teachers can do with the conventional textbooks. This type of teaching materials require teachers to operate in classroom. To be more specific, teacher can use the courseware as the instructor for the specific lesson, and children learn from and with the courseware (CTGV, 1993). In this case, the teachers' role is more on operating the teaching materials, and control the children in the classroom. In short, teachers' roles will focus more on social interaction in the classroom learning. Hence, the

teaching materials should be friendly and interesting to most students. In response to this, the theory of Multiple Intelligence should be considered. It emphazises that people are intelligent at different aspects: Verbal-linguistic intelligence, Mathematical-logical intelligence, Visual-spatial intelligence, Intrapersonal intelligence, Bodily-kinesthetic intelligence, Interpersonal, Naturalist intelligence, and Musical-rhythmic intelligence.

In response to the discussions in the previous paragraphs, Ariffin (2011) studied the guidelines of teaching materials for use in the pre-schools, which has been named EliteKids. The guidelines are detailed in Table 1.

Table 1. Guidelines for EliteKids

Content	• Following a standard syllabus. • Consist of a few chunks of topics, including exercise or quiz. • Simple and map children's existing knowledge. • Each topic is short. • Arranged according to thematic, increasing level of complexity, sequences of process, and the like. • Include elements within children's mental model.
Activities	• Listen – allow children to listen to narration • Read – encourage children to read the texts on screen • Witness / observe – Invite children to witness the characters in the learning material • Speak – invite children to speak-together, such as singing and count • Move – encourage children to move their body, such as clap their hands, and nod their heads
Media elements **a. Text**	• Use large fonts – such as 18-points • Make sure the difference between the background and foreground is obvious • Make sure the fonts are clear, use sans serif • The fonts must be simple, use wide character-fonts such as Bookman Old Style • Make sure there is no mistake
b. Audio	• Pronunciation must be clear, slowly, and right with emphasis, tone, and stress • Obvious difference between the background audio, audio alert, and the content • Good to be repetitive • User can control the audio • Use of multiple colors
c. Visual (graphic, animation, images, video, etc.)	• Use only appropriate animation • Make sure the visual elements are standard • All graphics must be clear • Provide multiple different characters • Use suitable metaphors for children
Interactivity	• Maintain the standard • Provide sign post • Provide audio alert • Provide visual alert • It has to be minimal • Encourage the use of mouse of touch screen • Buttons must be obvious • Use clear instructions • Avoid hierarchy
Language	• Use simple sentence structure • Use short sentences • Good to repeat • Provided in written and audio forms

The guidelines in Table 1 were gathered from the users in the context in the study, i.e. children and teachers at pre-school. They map with instructional criteria, which collects theories of famous persons such as Gardner, Merril, and Rogers. In EliteKids, children's learning ability is emphasized more than making it merely for fun. Hence, the instructional elements are important. Based on the guidelines, this paper outlines the design and development of EliteKids. The methods of designing and developing the EliteKids are described in the following.

METHOD

This paper extends the works explained in (Ariffin, 2011; Ariffin 2012), hence only the designing and development part is explained (as illustrated in Figure 1) with an extended discussion as well as the user test.

Design and Development of EliteKids

The EliteKids has been designed and developed by involving the real users; i.e. the children and teachers at pre-schools; into the activities. This means that all artifacts are shown to the users for their agreement. Referring to the diagram in Figure 1, this systematic process is called User-Centered Design (UCD).

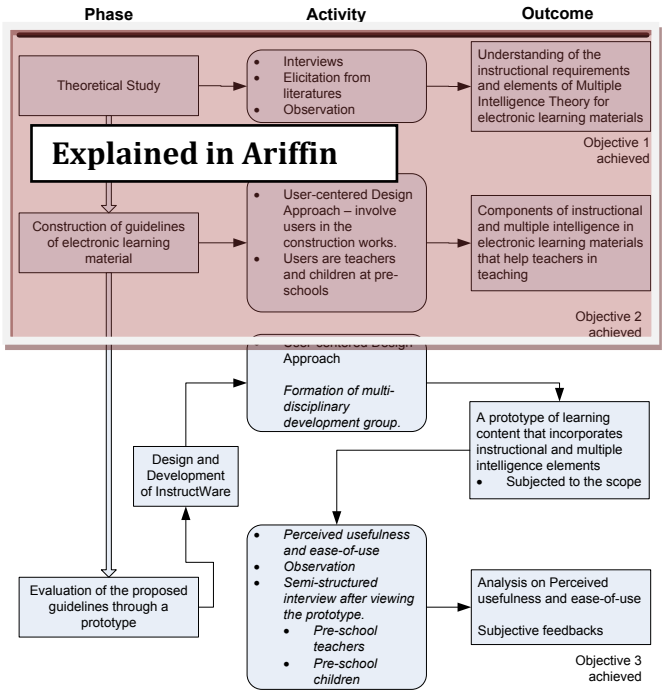

Figure 1: Activities and outcomes

In the design process, a few artifacts were produced. This study first decided on the content to be included in the EliteKids. English is selected for this study, because it is a language, which is practiced everywhere. At pre-school, children mostly learn English through simple words and about knowledge around them. In ensuring the content in the EliteKids is sufficient for children at pre-school, the syllabus provided by the ministry is taken as the basis. Accordingly, all contents in the EliteKids are based on the syllabus by the ministry.

Having obtained the content guidelines, as well as the design guidelines as listed in Table 1, the storyboard was developed, in which the samples are depicted in Figures 2 through 5.

In EliteKids, each unit provides four activities to users to select: listen, talk, read, and learn. The 'help' option provides the plan of activity for the users, meanwhile the 'lesson' option will take the users to the main page, in which the list of units are available. The buttons are indicated when they are being active. Figures 2 through 5 indicate different activities being carried out. Besides, the reading activities can be carried out by either singing a song or listening to the sound (Figure 5), in which users could freely select. On top of that, the 'talking' and 'learning' activities provides users with question-and-answer and practice activities as seen in Figure 4.

Based on the storyboard, the EliteKids was developed. This study decided to distribute the EliteKids in CD, hence developing it as a standalone application is sufficient. Accordingly, Flash was utilized for composing the scenes. Earlier, the audio was prepared first, using dubbing process in adobe Premierre. Finally the EliteKids has been realized, in which the following subsection describes its attributes.

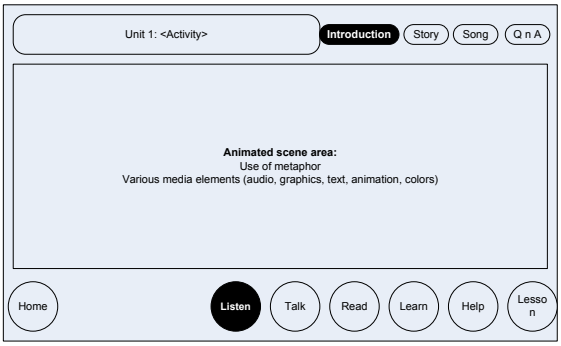

Figure 2: Storyboard – listening activity: introduction

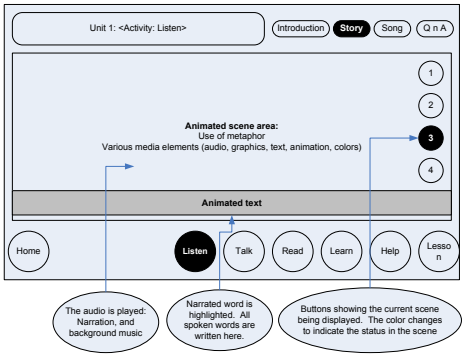

Figure 3: Storyboard – listening activity: story

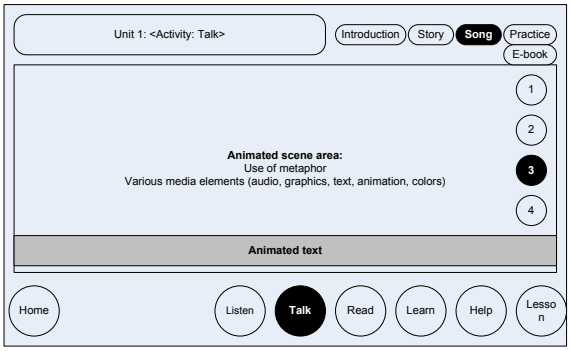

Figure 4: Storyboard – talking activity: singing together

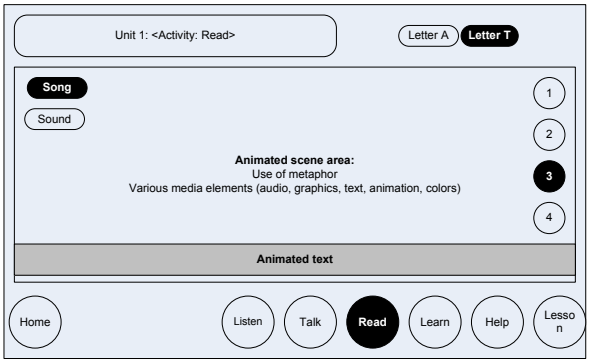

Figure 5: Storyboard – reading activity: singing about 'T'

The EliteKids

The main page of EliteKids is depicted in Figure 6. Users can select the unit from those available. If they click the 'next' button, the next units are available. All units are provided with their respective title, in which Unit 1 is about 'myself' is an example. If the users click Unit 1, the page as shown in Figure 7 is displayed. By default, all units when visited starts with listening activity.

It could be observed at its page title and the icons at the bottom as depicted in Figure 7. When the content is long, the status indicator is provided, in the form of buttons as depicted in Figure 8, that user can click. Besides functioning as the status indicator, the buttons also enable users to revisit any intended scene.

Figure 6: The main page

Figure 7: Introduction section in Unit 1

Figure 8: The story in listening activity

Besides listening to the story, users can sing together with the characters in the EliteKids as depicted in Figure 9. This provides motivational elements for people who tend to move (*bodily-kinesthetic intelligence*) and people who like music (*musical-rhythmic intelligence*). When singing together, users can read the provided narrated text. The pronunciation in EliteKids is well tested, making the users learn with correct pronunciation. Hence, at the same time, they are ensured pronouncing well (*verbal-linguistic intelligence*).

Figure 9: Singing a song in listening activity

The question-and-answer mode as depicted in Figure 10 ensures users involve in the activity. They can click any sentences to listen to the conversation again. In this kind of activity, users tend to answer the questions (*intrapersonal intelligence*), which stimulus their cognitive development.

Figure 10: Dialogue in the form of question-n-answer

Then, when the users activate a new activity, the title is changed as seen in Figure 11, indicating the new activity. In talking activity, the practice and e-book sections are available.

Figure 11: Storytelling in talking activity

Figure 12 shows that in the e-book, a conversation is provided, in which users can practice among themselves (*interpersonal intelligence*). The metaphor is EliteKids always ensures natural elements exists (*naturalist intelligence*). Furthermore, there are various scenes utilized in EliteKids to support users' interest. In a way, it also stimulates cognitive development through the spaces (*visual-spatial intelligence*).

Figure 12: Storyboard – learning activity: in words

RESULT

The previous section illustrates that the EliteKids gathers all guidelines as listed in Table 1, and the recommendations in Multiple Intelligence. Then, the prototype was piloted with the users. It was aimed at evaluating how usable it is. Thirty children from four pre-schools were involved in the testing. Besides, eight teachers who teach the children were also involved. In the test, they were let to experience the EliteKids. They were observed while using the EliteKids. Then, they were interviewed.

Observation

From the observation, this study found that all users were very excited with the EliteKids. All children especially were singing along with the EliteKids when appropriate. When there is any dialogue, they involve by including themselves in the content in the EliteKids. Also, when necessary, the children involve their partners in the conversation. Both groups of users were happily practicing the sentences, clicking the repeat buttons to ensure they could copy the pronunciations. It was observed that they were trying to pronounce the words at their best.

Interview

The users were interview using unstructured format. All users were asked on how they think the EliteKids serves their needs. It was not surprised when they all agreed that the EliteKids helps them very much. Among the thirty children, there were different personalities. However, the feedbacks to the interview reveal that they were all encouraged by the EliteKids. On top of that, teachers were also happy with the model in EliteKids. It helps their job a lot, in which the EliteKids could teach both themselves and the children.

DISCUSSION

Children at pre-school are still very young. Their context is full of happiness. At the same time, their excitement to learn is high. Hence, understanding their needs in designing learning materials for them is necessary. Based on the guidelines in Table 1, this section summarizes the findings from both observation and interviews in Table 2.

Qualitative Measurement

In qualitative approach, data were gathered through observation and interviews. The 14 pre-schools were visited with special purposes for evaluating the EliteKids. During the visit, the EliteKids was installed into the computer and let the teachers teach with the EliteKids. This study observed their teaching practice first. Before the exit meeting, the teachers were also interviewed on the experience while handling classroom teaching with assistance of the InstructWare.

During the observation, teachers were allowed to teach co-operatively in a single class. It is important to motivate them. This study does not have any doubt upon the co-operative teaching, because teaching alone and in small group using InstructWare does not have any difference. They carried out their task as usual, but with help of the EliteKids. They were mentioned about the evaluation purposes in advance, so the schools were prepared for the session. However, the children were not mentioned about the session, to ensure thay behave naturally during the observation.

This study took a period (30 minutes), as scheduled (for English subject), for observing the teaching practice. It is a normal teaching period at pre-schools. It is very important, so that both teachers and children are not affected by any time-related factor. During the observation, this study noted the facts regarding the guidelines down. Samples of observations are depicted in Figure 13.

Figure 13: Observation activity

Having observed the teaching practice with helps of the InstructWare, this study asked the teachers some questions for confirming the notes taken. It was ultimately unstructured, in which open questions regarding the notes taken were addressed. In short, the questions were asked to clerify the data gathered through the observation, hence there was no specific questioned outlined in advance.

Having observed and interviewed, significant findings have been gathered. The data are rich, because they were collected from 14 pre-schools. Regarding the observation activities, the trend was clear that observing three to five pre-schools are sufficient because the remaining observation only repeats the findings. Hence, the findings are listed in Table 5.1.

The findings in Table 2 explains that the guidelines assist a lot in designing the EliteKids. Further, the EliteKids assists teachers in their teaching activities a lot. It was observed that both teachers and children enjoyed the sessions. In short, teachers were observed confident in teaching with helps of the EliteKids, and children were observed enjoyed learning with helps of the EliteKids.

Although this study is happy with the findings, some emperical data were also obtained to further confirm that the InstructWare is usable for the teaching purposes. Hence, an empirical study was carried out, and is explained in the next section.

Empirical Measurement

The empirical data were collected to determine the usability of the EliteKids. The findings of the study proves the ability of the proposed guidelines in ensuring that EliteKids is usable. Hence, appropriate data were gathered from the actual users.

CSUQ (Lewis, 1995) is utilized in this study after considering (1) it is very simple, suitable to obtain desired feedback and at the same time keeping the subjects' interest in responding to the questionnaires, (2) it has a non-threatening manner, so as to encourage the subjects in answering the questions, and (3) it has a clear format and specific topics. Hence, the CSUQ was perfectly adopted, consisting eighteen items which are divided into four dimensions, namely: Section A: Usefulness; Section B: Content Quality; Section C: Interface Quality; and Section D: Overall Satisfaction.

Table 2: Summary of qualitative findings

Instructional / Multiple Intelligence		Findings
Content	• Following a standard syllabus. • Consist of a few chunks of topics, including exercise or quiz. • Simple and map children's existing knowledge. • Each topic is short. • Arranged according to thematic, increasing level of complexity, sequences of process, and the like. • Include elements within children's mental model.	The teachers agree with the depth and breadth of the contents, as long as it follows the syllabus. The idea of chunking the contents into topics maps the current practice. Teachers and children follow the themes in the InstructWare happily. Children can associate the contents well with their existing knowledge. **Note**: The use of animated characters in appropriate metaphor in EliteKids makes learning fun for the children.
Media elements **a. Text**	• Use large fonts – such as 18-points. • Make sure the difference between the background and foreground is obvious. • Make sure the fonts are clear, use sans serif. • The fonts must be simple, use wide character-fonts such as Bookman Old Style.	The font size is important, in terms of colors, size, style, and matching with the background.
b. Audio	• Make sure there is no mistake. • Pronunciation must be clear, slowly, and right with emphasis, tone, and stress. • Obvious difference between the background audio, audio alert, and the content. • Good to be repetitive. • User can control the audio.	In terms of the audio, it is also important. Normal children expect for the audio, but it should allow the children to control their volume. During the observation, it was found that all children enjoyed the song, because EliteKids constructs its own song, mapping the content. This study calls them content songs. When it could be repeated, children like it even more. They ask their teacher to repeat (when applicable) until each of them involve. With that, they get the contents quickly.
c. Visual (graphic, animation, images, video, etc..)	• Use of multiple colors. • Use only appropriate animation. • Make sure the visual elements are standard. • All graphics must be clear. • Provide multiple different characters. • Use suitable metaphors for children.	The various colors (mainly red, blue, yellow, and green) attract children at their first sight. This captures their attention to the teaching material. The standardization is important. No user was found confused with the visual elements in EliteKids. The minimized animations, available only when necessary ensure that children focus on the learning content. Partly, because it does not overload their cognitive. On top of that, the metaphors in EliteKids do not confuse the children in their learning flow. None of them asked any question, which explains that the metaphors influence their learning engagement positively.

Inter-activity	• Maintain the standard. • Provide sign post. • Provide audio alert. • Provide visual alert. • It has to be minimal. • Encourage the use of mouse or touch screen. • Buttons must be obvious. • Use clear instructions. • Avoid hierarchy.	Standardization in EliteKids avoids users from lost. It was found that the teachers never navigate wrongly after they have learned from the first or second mistakes. This supports children interest and confidence also. Signpost, audio, and visual alerts are also very significant in notifying users about their actions. Although teachers use the EliteKids for the first time, they were not confused between clickable and non-clickable items, and felt very confident in interacting. They mentioned that the signpost, audio alert, and visual alert make them confident. On top of that, the obvious buttons also make them confident. Additionally, they have freedom in EliteKids to navigate through without being forced in a linear step. This allows them to plan their teaching according with special reflection to the current situation. It is important because they have to tailor their teaching appropriate to the children, who always trigger behavior change.
Language	• Use simple sentence structure. • Use short sentences. • Good to repeat. • Provided in written and audio forms.	The children were seen happily participating in the learning activities. Short sentences enable them to imitate the contents. They were help a lot by the narration, especially with proper pronunciations, emphasis, and stress. Nevertheless, they got clearer when the ambiguous parts are repeated. In the end, the children could make-up simple dialogues nicely and confidently. Hence, this study deduces that for all applications for children, the sentence structure must be simple with short sentences. Repetition is also good to support children learning, with the spoken words are written.
Method	• Listen – allow children to listen to narration. (A) • Read – encourage children to read the texts on screen. • Witness / observe – Invite children to witness the characters in the learning material. (V) • Speak – invite children to speak-together, such as singing and count. • Move – encourage children to move their body, such as clap their hands, and nod their heads. (K)	The children enjoyed the listening part a lot. It is supported with written text. This develops their confidence significantly. It results in their ability to grab new vocabularies and sentence structures. It is especially meaningful because EliteKids highlights the word being pronounced with different color, so the children follow the contents exactly. Besides, the characters also describe certain concepts through their behavior and body languages. Children were observed imitating their body languages when practicing the sentences. They not only speak with their peers, but also with their teachers and answering questions together when the EliteKids asks questions. They move physically along with the EliteKids, especially when singing songs and demonstrating body languages. In short, all users enjoy the activities: listen, read, witness /observe, speak, and move. They clap their hands, twist their body, sing together, smile, read the text, listen to the audio, and speak to others.

Since subjects are of low proficiency level, simplicity in response is given due importance (Lewis & Porter, 2004; Terrell, 1958) furthermore, it has been proven that children evaluate some statement as part of the whole statement (Smith, 1980). Therefore, the items are measured by responding whether they agree or disagree with the statement in each dimension. The results of the evaluation are shown in Tables 3, 4, 5, and 6.

Although this study involves 14 pre-schools, with three teachers in each school, the empirical results were only obtained from 21 answered CSUQ. This is because some teachers answered the CSUQ together. However, this study does not anticipate any defeciency with the number because only percentages are the final meaningful results and data are not processed using any statistical package.

Each dimension is discussed separately. In regards to the background of the teachers, who are not highly motivated in answering questionairre, only agree and disagree options are provided for them to choose. Hence, percentages could already explain about the usability.

Usefulness

From the responses in Table 3, it was gathered that 100% of the teachers were satisfied with the usefulness of the EliteKids which enables them to complete the activity effectively and comfortably. A sum of 95.24% agreed that it was easy to teach using the EliteKids and it helps them to improve their vocabulary, whereas only 4.76% disagreed with this. Additionally, 90.48% found that EliteKids is simple, whereby only 9.52% disagreed with it. 85.71% of the teachers agreed that they could finish teaching with EliteKids in a short time, while another 14.29% was unable to do so.

Table 3: Usefulness

Item	Description	Agree		Disagree	
1	I am satisfied with the teaching activity with EliteKids because it is easy to use.	21	100%	0	0%
2	I can complete the teaching activities with help of EliteKids effectively.	21	100%	0	0%
3	I find the InstructWare is simple.	19	90.48%	2	9.52%
4	I can complete the activities in EliteKids quickly.	18	85.71%	3	14.29%
5	I feel comfortable with the EliteKids.	21	100%		
6	It was easy to teach using EliteKids.	20	95.24%	1	4.76%
7	I believe I can improve my vocabulary using EliteKids.	20	95.24%	1	4.76%

From the findings in the above paragraph, this study believes that the EliteKids has been a good teaching material for teachers in pre-schools. They found that the teaching material is very useful in assisting them teaching.

Content Quality

Table 4 describes the elements on the content quality of the EliteKids. All teachers agreed that they were able to correct errors and find information needed easily, that the information supplied is

Table 5.4: Content Quality

Item	Description	Agree		Disagree	
8	The instructions in EliteKids are clear.	19	90.48%	2	9.52%
9	I can correct my errors easily.	21	100%	0	0%
10	It is easy to find the information I need.	21	100%	0	0%
11	The information provided in the EliteKids is easy to understand.	18	85.71%	3	14.29%
12	The information given is effective in helping me using the EliteKids.	21	100%	0	0%
13	The organization of information in the EliteKids is clear.	21	100%	0	0%
14	The music is appealing.	21	100%	0	0%

effective in assisting the task completion, the organization of information is clear and the music used is appealing to them. As for the clarity in instruction given, 90.48% agreed, while a small sum of 9.52% disagreed. 85.71% of the subjects claimed that the information the EliteKids was effective in completing the activity, however, another 14.29% opposed to this.

The findings in Table 4 as described in the above paragraph explain that the content quality in EliteKids is clear. They explain that the information in teaching materials for pre-school must be very minimal, and requires less mental efforts (Duggan, 2009). This is important in efforts to start engaging them into learning activities (Shahrier, Anton, & Hamamah, 2010; Warren & Devrics, 2009).

Interface Quality

With reference to Table 5, on the part of interface quality of the EliteKids, all subjects agreed that the interface is pleasant and they liked using icons and clues provided in the EliteKids as they have user-friendly functions.

Table 5: Interface Quality

Item	Description	Agree		Disagree	
15	The interface is pleasant.	21	100%	0	0%
16	I like using the interface of the EliteKids.	21	100%	0	0%
17	The functions in the EliteKids are user friendly.	21	100%	0	0%

Accordingly, this study strongly recommends that teaching materials for pre-school children should be very pleasing (Bourke, Rigby, & Burden, 2000). It was found that the EliteKids was highly preferred by the teachers and children. In addition to that, Chen, Mashadi, Ang, and Harkrider (1999) also emphasize that cultural inclusivity is one of the fundamental foundations in creating learning environment as it will enable students to retrieve learning resources in a manner that is congruent with their styles of learning, beliefs, and values.

Overall Satisfaction

On the whole, the EliteKids received an overwhelming acceptance from the 21 pre-school teachers as 100% fully agreed that it can be accepted as a tool for them to teach in pre-school. The responses are listed in Table 6.

Table 6: Overall Satisfaction

Item	Description	Agree		Disagree	
18	Overall, I can accept the InstructWare as a tool to teach.	21	100%	0	0%

In accordance to the above paragraph, this study believes that the teachers are prepared to utilize computer-enhanced teaching materials in their teaching activities.

CONCLUSION

This paper describes the design and development of a usable teaching material called EliteKids. Findings of the user test reveal that the EliteKids is useful, and assisting teachers in their tasts. Additionally (which is more important), children enjoy learning with EliteKids.

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Ariffin Abdul Mutalib
School of Multimedia Technology and Communication,
Universiti Utara Malaysia, am.ariffin@uum.edu.my

18

A Simulation Study of State-Feedback Control Method for Electro Hydraulic Servo Model

M. H. Jusoh, F. N. Zohedi & M. H. Jali

ABSTRACT

Electro hydraulic servo system is used by many industries due to its ability to impart large forces. It also has advantage in term of fast response and robustness. The electro hydraulic system suffered from errors of the transient response which are steady state error, settling time and the ripples. It is crucial to design a controller for the system to ensure the reliability of the system. Aiming at the characteristic of the system, steady state feedback control method is designed to compensate the error. The analysis of the system is done based on the transient response specifically on the actuator part. MATLAB Simulink is used as the simulation software to evaluate the force performance of state feedback controller method. The steady state error, settling time and ripple are observed and recorded for each controller. Three methods is applied, which are full feedback, state feedback with feed forward and integral control are compared with proportional, integral and derivatives (PID) controller. The result of each controller shows the differences performance. Based on the simulation results, the feedforward technique is found to be the best control technique for the electro hydraulic servo system due to the requirement performance such as percent overshoot, settling time, rise time and zero steady state error. This good result will directly benefit industries that use electro hydraulic system as their actuator for production machines.

Keyword: electro hydraulic force servo system; state feedback; PID controller

ABSTRAK

Sistem elektro hidraulik servo ini telah digunakan meluas di kawasan – kawasan industry disebabkan oleh keupayaannya yang memberi kuasa besar. Sistem ini juga mempunyai kelebihan dari segi ”fast response” dan “robustness”. System ini menjadi teruk disebabkan oleh “transient response” seperti ralat, masa untuk mencapai keaadaan mantap adalah tinggi. Berdasarkan kriteria – kriteria di dalam system ini, “state feedback control method” telah di reka untuk mengurangjan ralat. Analisis bagi system ini dibuat berdasarkan “transient response” terutamanya di bahagian penggerak. Matlab Simulink telah digunakan sebagai perisian simulasi untuk menilai nilai daya bagi “state feedback control method”. Semua kriteria diperhati dan di rekod bagi tujuan analisis. Tiga kaedah telah digunakan dimana” full feedback, state feedback with feed forward and integral control” dan akan dibandingkan dengan PID. Keputusan setiap controller telah menunjukkan perbezaaan dari segi kriteria nya. Berdasarkan keputusan yang telah dibuat didapati “feedback with feedforward” adalah teknik control yang terbaik bagi siste elektro hidraulik servo system.

Kata kunci: sistem elektrik hidraulik; kawalan suap balik; kawalan PID

INTRODUCTION

Electro hydraulic system has become resurgence of interest to many academicians, researchers and engineers worldwide since World War II. Hydraulics refers to the mechanism and system transmitting power all the way liquids. The fundamental scheme behind any hydraulic system is very straightforward in the sense that force that is applied at one point is transmitted to another point using an incompressible fluid and the fluid is almost always an oil of various sorts. The need to develop a method for transmitting power from one point to another has led to the introduction of hydraulic system. The expansion of hydraulic control has paralleled developments in numerous applications such as transportation, industrial machinery, air craft, ship control and so on. Electro hydraulic servo system is widely employed in industrial applications such as robotic manipulators, active suspensions, precision machine tools and aerospace systems [1]. Hydraulic system is a complicated system due to various components of mechanic, electric and hydraulic. The system suffered with bad transient response due to these various components. It has high steady state error and oscillations at the beginning of the response. It cause the system damage if the force given too high. Therefore, controller base on state feedback method is designed to improve the system transient response. The performance is analysis based on percent overshoot, settling time, rise time, steady state error and gets the best response. The best transient response should have low percent overshoot, low settling time, low rise time, and zero steady state error.

This paper is organized as follows. Section II describes in detail about modelling of electro hydraulic servo system. Section III explain throughly the control method that involved in the research works. Section IV presents results and discussion of each control method using simulink MATLAB. Section V summaryze the findings and finally, section V will describes the conclusion of this research.

MODELLING OF ELECTRO HYDRAULIC SERVO SYSTEM

In order to provide mathematic basis for choosing control strategy, the mathematic model of electro-hydraulic force servo control system was built and analyzed.

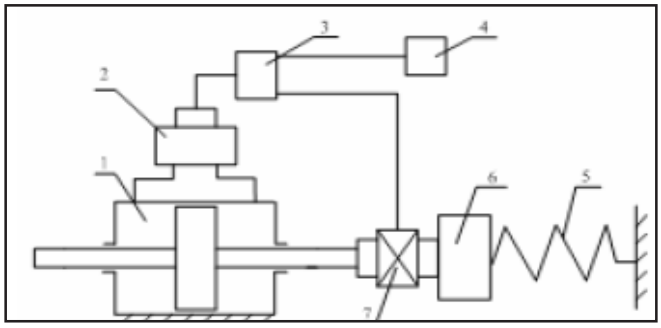

Figure 1: The schematic diagram of electro-hydraulic servo model 1-cylinder, 2-electro-hydraulic servo valve, 3-controller, 4- signal generator, 5-elastic load, 6-inertia load, 7-force sensor

Based on figure 1, the typical driving force servo system consist of cylinder, electro hydraulic servo valve, controller, signal generator, elastic load, inertia load, and force sensor. The signal generator will generate a signal to operate the valve. The signal will control the orifices size of

the value and the fluid will flow through the orifice. The bigger size of orifice, the more fluid will flow. The fluid will fill in the cylinder and produce force. The more fluid flow will produce more force. If the input signal is 1V then the output force is 1N. The output is measured by using force sensor. Then it is converted to electric signal and feedback to the source signal.

The transfer function of electro force servo system for hydraulic cylinder is given based on the data parameters of cylinder that from the reference journal [1]. The transfer function of the electro hydraulic servo system is obtained based on the parameter. The transfer functions of the system as follow [1].

$$\frac{\frac{1}{K_{ce}}\left(\frac{s^2}{\omega_m^2}+\frac{2\xi_m^2 s}{\omega_m}+1\right)}{\left(\frac{s}{\omega_r}+1\right)\left(\frac{s^2}{\omega_0^2}+\frac{2\xi_o s}{\omega_o}+1\right)} \quad (1)$$

The transfer function produce an output that has high steady state error and ripple as in figure 2 below.

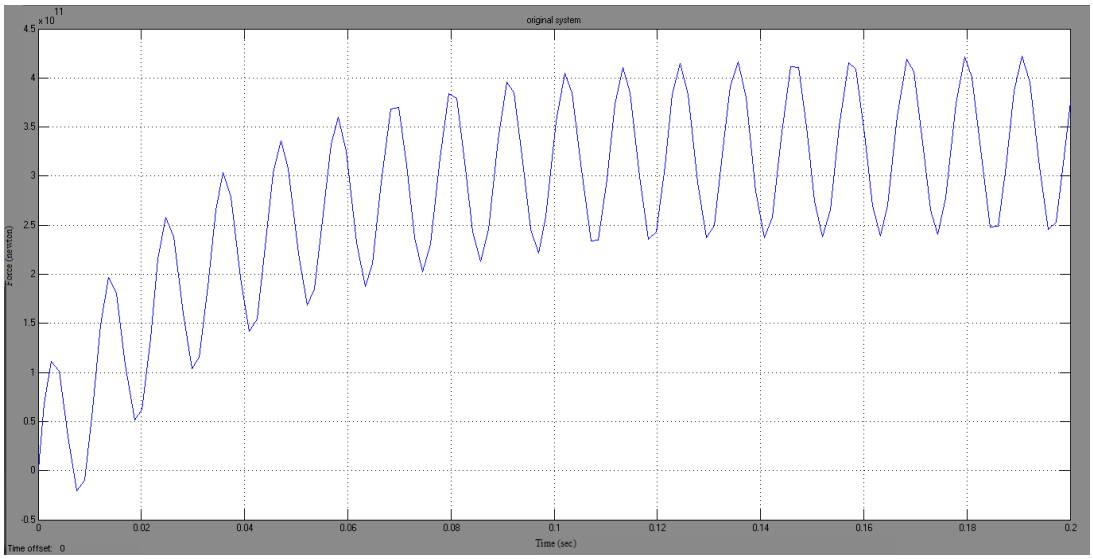

Figure 2: The output of the EHS model.

CONTROL METHOD

The control method discussed in this paper is modern control method which consist full state feedback, feedback with feedfoward and integral and traditional control method which is PID control method.

Full state feedback

There are two approaches to design feedback control system. First is a frequency domain which is also called classical approach. It is an approach that represents the output to the input. It is done by converting system's differential equation to transfer function, hence mathematical equation can be generated. It is however, has drawback in term of applicability to only linear time invariant system [6].

Second approach is state space approach that also known as modern and time domain approach. It start when the control system become more complicated due to introduction of space exploration. In a modern world, system has become more stringent in term of performance, system complexity, and easy access by computer and advance control theory which is highly demand [5]. It is the approach that covers comprehensively wide range of system such as nonlinear system, non-zero initial condition and time varying system.

Full-State-feedback is a state space control technique that been used in the modern control system. One of the techniques to obtain the feedback gain is by using pole placement technique. It is a method used in the feedback control to place the closed-loop poles of a system in pre-determined locations in s-plan. Placing poles is desirable because the location of the poles corresponds directly to the eigenvalues of the system, which control the characteristics of the response of the system. The system must be controllable in order to implement this method. Pole placement technique is designed to allow the placement of poles at desired locations, provided the system is controllable. For this simulation EHS model, the selected eigenvalue is -100 as equation 2 below.

$$[sI - A + BK] = (s - \mu_1)(s - \mu_2)(s - \mu_3) = 0 \quad (2)$$

State feedback with feed forward

By considering state space conditions, an appropriate forward gain matrix can be design to eliminate any steady state error. A reference input can be introduced to study the transient response of the closed loop system. If a step input is applied a steady state error is present. Hence, it needs a controller that gives zero steady state error for any constant input.

By considering steady state conditions, an appropriate forward gain matrix can be design to eliminate any steady state error. The step to calculate the feedback gain N as follow;

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} N_x \\ N_u \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad (3)$$

$$\begin{bmatrix} N_x \\ N_u \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}^{-1} \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad (4)$$

Integral control

Integral control is another kind of pole placement technique that is known as tracking controller which it required output to follow input command signal. The feedback from the output is feedforward to the controlled via integrator, which is it is also known as integral action. It is used to increase the system type and also reduce the previous finite error to zero [4]. The derivation of this integral control is shown below;

$\dot{V} = r - y$ $\dot{V} = r - y$, where $y = Cxy = Cx$

$\dot{V} = -Cx + r$

$u = -Kx + Nv$

The compensation system for the integral control becomes;

$$\begin{bmatrix} \dot{x} \\ \dot{V} \end{bmatrix} = \begin{bmatrix} A - BK & BN \\ -C & 0 \end{bmatrix} \begin{bmatrix} x \\ v \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r \,, \; y = \begin{bmatrix} C & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

The characteristic polynomial of the compensated system is equated with the desired polynomial to solve for the controller gain, K and N.

PID controller

Conventional PID controller was chosen because the controller is widely used in many research and development today. Besides that PID controller is not a complex controller, simplicity in structure and easy to implement compare to the advance controller. PID controller is the combining of two controller which is PI controller and PD controller. Two type of this controller has its characteristic. PI controller is use to reduce steady state error while PD controller is act to reduce settling time, avoid unacceptable overshoot and improve system dynamic performance in order to make a stable system[6]. Equation 5 below shows the controller equation of PID.

$$u(t) = K_P e(t) + K_i \int_0^t e(\tau)d\tau + K_d \frac{d}{dt} e(t) \tag{5}$$

RESULT AND DISCUSSION

Full state feedback

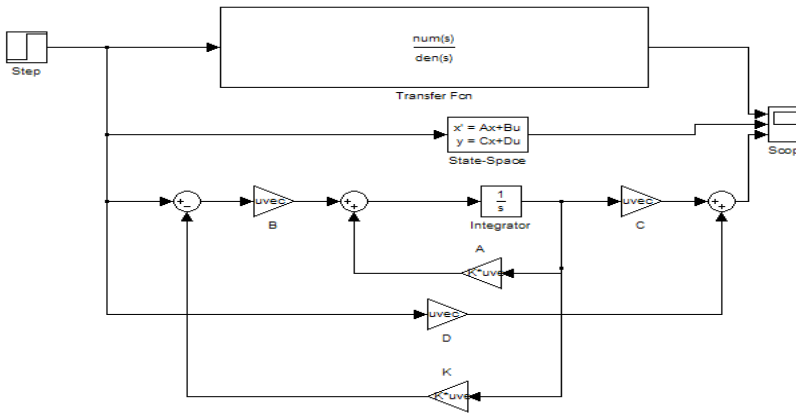

Figure 3: Full state feedback block diagram

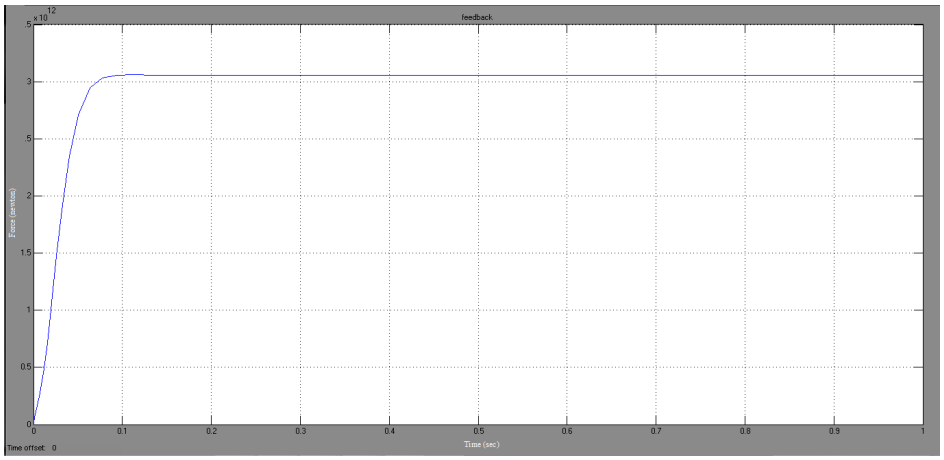

Figure 4: Output of Full state feedback controller

Figure 3 shows the full state feedback block diagram for EHS model. The output result is shown in figure 4. Based on the graphs in Figure 4, the rise time, settling time, steady state and error is measured as table 1. The ripple from the original system is eliminated but the steady state error is still very high.

Table 1: Characteristic of full state feedback controller

%overshoot	Rise time	Settling time	Steady state	Error
0	0.02s	0.05s	$3.01 * 10^{12}\ N$	$2.01 * 10^{12}$

Feedback with feedforward

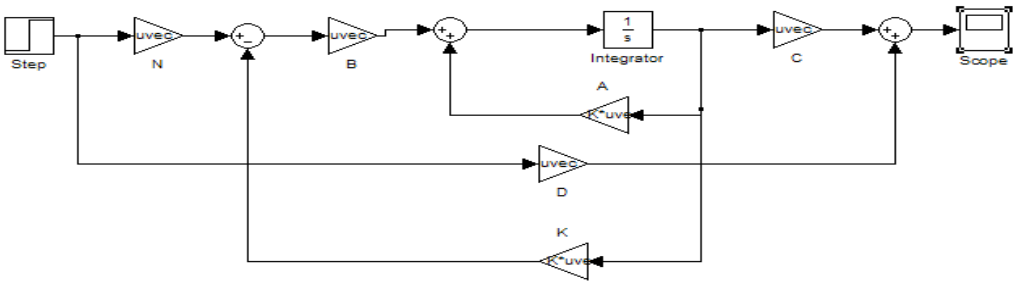

Figure 5: Feedback and feed forward controller block diagram

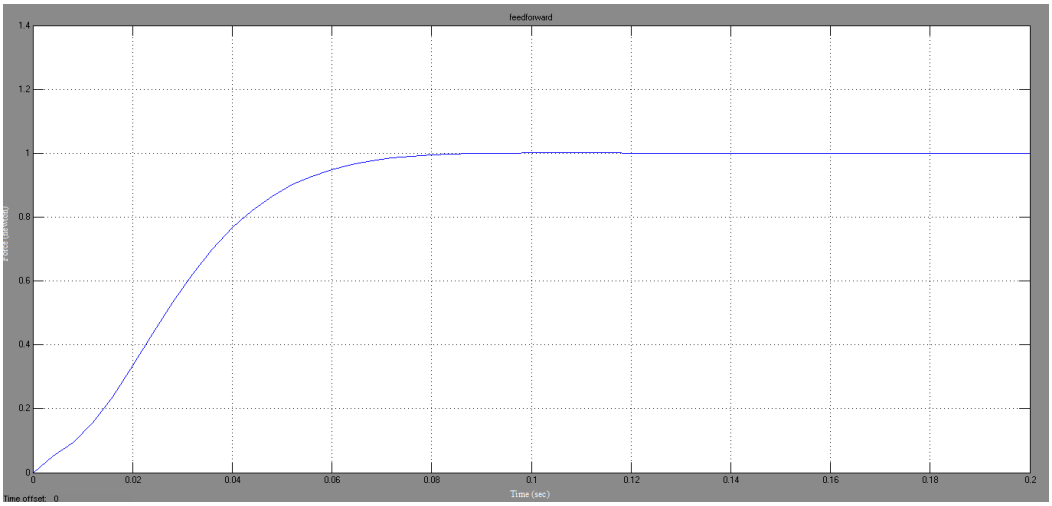

Figure 6: Output of feedback with feedforward controller

Figure 5 shows the state feedback with feed forward block diagram for EHS model. The output result is shown in figure 6 is very promising. Based on the graphs in Figure 4, the rise time, settling time, steady state and error is measured as table 2. The ripple from the original system is eliminated and the steady state error is zero.

Table 2: Characteristic of feedback and feed forward controller

%overshoot	Rise-time	Settling time	Steady State
0	0.02s	0.044s	1N

Integral control

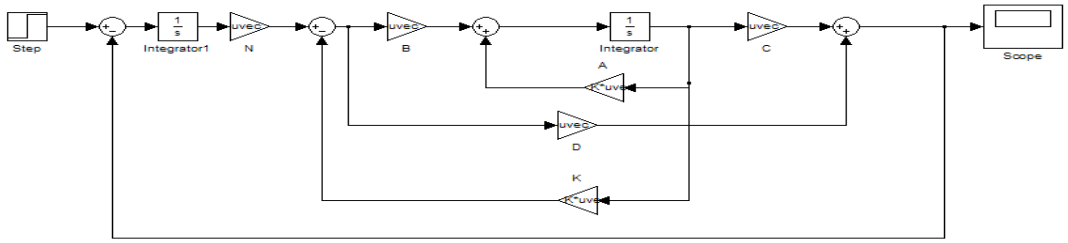

Figure 7: Integral controller block diagram

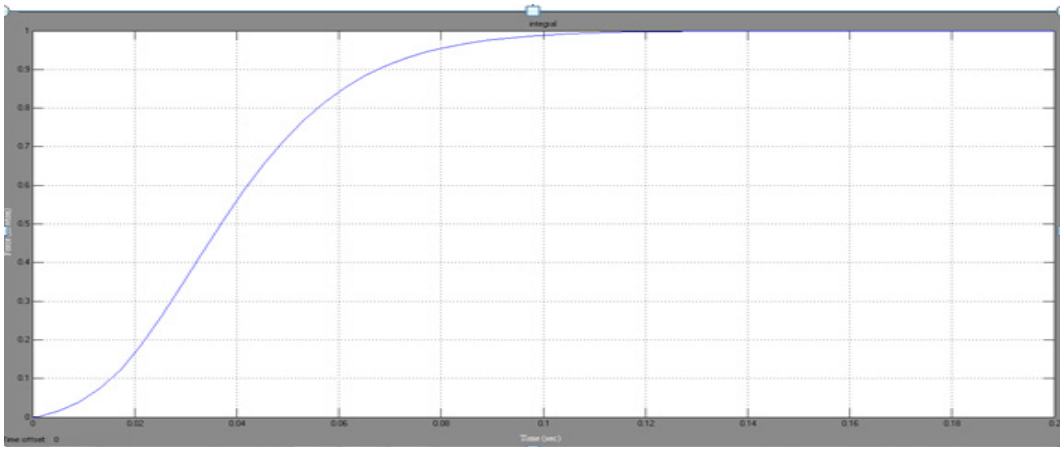

Figure 8: Output of integral controller

Figure 7 shows the state feedback with integral controller block diagram for EHS model. The output result is shown in figure 8 where the rise time, settling time, steady state and error is measured as table 3. The ripple from the original system is eliminated and the steady state error is zero.

Table 3: Characteristic of integral controller

%overshoot	Rise-time	Settling time	Steady State
0	0.04s	0.08s	1N

PID controller

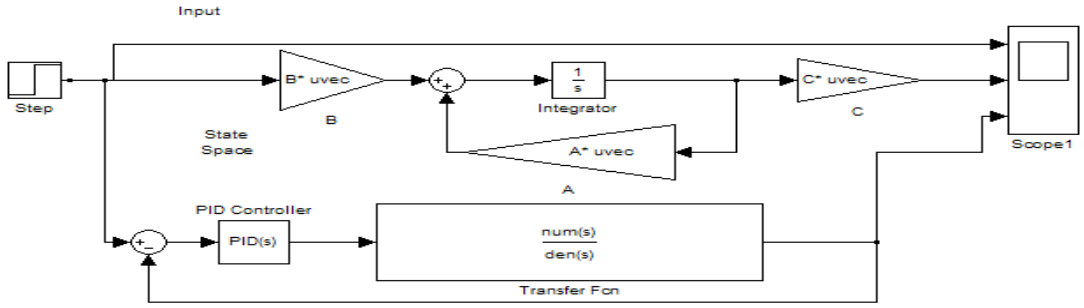

Figure 9: PID controller block diagram

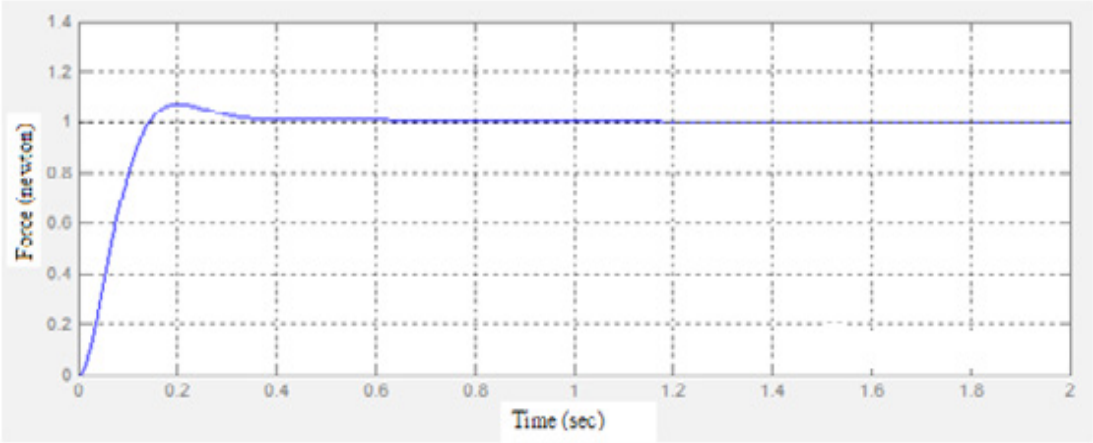

Figure 10: Output of PID controller

Figure 9 shows the state feedback with integral controller block diagram for EHS model. The output result is shown in figure 10 where the rise time, settling time, steady state and error is measured as table 4. The ripple from the original system is eliminated and the steady state error is zero but there is overshoot in the system.

Table 4: Characteristic of the PID controller

Requirement	PID response
Rise time, $T_r T_r$ (sec)	1.3
Settling time, $T_s T_s$ (sec)	4.34
Overshoot, (%OS)	11.6 %
Peak time, $T_p T_p$ (sec)	1.12

SUMMARY

All the results obtained throughout the project are presented and analyzed. First of all, the result and analysis of the original system without controllers are evaluated and it shown that the time to achieve steady state is low. Therefore, the controller is applied towards the system to improve the transient performance of the system. So, after all the simulations done and the final result are achieved, the comparison analyses are done. The result shows the feedforward controller is the best controller of this system because the time to achieve the steady state is fast compare to PID and the modern control technique tested. Table 5 shows the overall results of the research project.

Table 5: Table of project analysis

	Project analysis			
Requirement	**PID**	**Full state feedback**	**State feedback with feed forward**	**Integral**
(%) overshoot	11.6%	0	0	0
Steady state, N	1	$3.01 * 10^{12}\ N$	1	1
Settling time, s	4.34	0.05s	0.044s	0.08
Rise time, s	1.3	0.02s	0.02s	0.04
error	0	$2.01 * 10^{12}$	0	0

CONCLUSION AND RECOMMENDATION

Based on the simulation results, the feedforward technique is found to be the best control technique for the electro hydraulic servo model. It is capable to achieve the desired performance target that has the best trade – off between the requirements. The main contributions of this research are the decision on the best control technique that is suitable for electro hydraulic servo system.

For future research it is recommended that fuzzy logic or other artificial controller is implemanted for EHS model. The the simulation is being done for various type of cylinder, which is in this research use double acting cylinder.

ACKNOWLEDGMENTS

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M. H. Jusoh
Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
shima_iema89@yahoo.com(013-9550830)

F. N. Zohedi
Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
fauzal@utem.edu.my(06-5552279)

M. H. Jali
Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
mohd.hafiz@utem.edu.my (06-5552331)

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Membezakan Tanggapan Kelantangan Bunyi dengan Menggunakan Nada Sinus Berulangan

Mai Mariam Mohamed Aminuddin, Izadora Mustaffa
& Hairulisam Md Dom

ABSTRAK

Semasa proses tetapan peranti bantuan pendengaran, tahap paling kuat tetapi selesa (PKS) adalah tahap kelantangan bunyi yang paling sukar ditentukan dengan tepat melalui kaedah yang sedia ada iaitu secara lisan atau pun tingkah laku. Ini adalah kerana pengguna peranti bantuan pendengaran ini harus menilaikan sendiri tahap kelantangan bunyi yang diberikan. Oleh kerana tahap ini adalah tahap yang bersempadan dengan tahap yang sangat kuat tetapi tidak selesa (SKTS), ianya amat mengelirukan pengguna. Tahap SKTS tidak diambil kira untuk penentuan skala kelantangan bunyi kerana untuk jangka masa yang lama, tahap ini akan merosakkan pendengaran pengguna. Proses tetapan akan lebih mencabar jika pengguna tidak pernah ada pengalaman mendengar seperti kanak-kanak. Oleh yang demikian, untuk satu kaedah pengukuran skala kelantangan bunyi yang objektif, kesan penurunan puncak gelombang N100 terhadap tahap tanggapan kelantangan bunyi dikaji bagi membezakan antara tahap PKS dan SKTS di dalam kajian ini. Hasilnya, peratusan penurunan puncak N100 dilihat menurun dengan peningkatan kelantangan bunyi. Daripada hasil keputusan, didapati bahawa bagi tahap SKTS, peratusan penurunan puncak N100 tidak melebihi 1.95% oleh 3 daripada 7 subjek. Manakala PKS menunjukkan peratusan penurunan puncak N100 yang lebih tinggi daripada SKTS dan lebih rendah daripada tahap SEDERHANA. Kesimpulannya, tanggapan kelantangan bunyi boleh diukur melalui peratusan penurunan puncak N100 dan kaedah ini boleh digunakan untuk tetapan peranti bantuan pendengaran secara objektif.

ABSTRACT

During the setting of hearing aid device process, the most comfortable loud (MCL) level is the most difficult level to determine with by existing methods i.e., verbal or behavioral technique. This is because the hearing aid device users should evaluate their own given the volume level. The users might find it confusing as this level is next to uncomfortable loud level (UCL). UCL level is not taken into account for the determination of the loudness scaling as in a long period it will damage the user's hearing. The setting process will be more challenging if the user does not have any listening experience such as a child. Thus, the relationship in between the decline of the N100 wave peak and loudness perception is studied to distinguish between the MCL and UCL for an objective loudness scaling measurement. As a result, the percentage decrease in N100 peak decreased with increasing volume is observed. From the results, it was found that for the level UCL, the percentage decrease in peak N100 does not exceed 1.95% by 3 out of 7 subjects. While MCL showed the percentage decrease in N100 peak higher than UCL and lower than the MEDIUM. In conclusion, the loudness perception can be measured by the percentage decrease in peak N100 and this method can be used to adjust the hearing aid device objectively.

Kata kunci : Penurunan N100; Habituasi; Tanggapan kelantangan bunyi.

PENGENALAN

Menentukan tahap paling kuat tetapi selesa (PKS) adalah tugas yang sukar semasa proses tetapan peranti bantuan pendengaran. Pernyataan ini dipersetujui oleh kebanyakkan juru audio (Punch et. al, 2004). Tugas ini semakin sukar apabila peranti bantuan pendengaran menjadi lebih canggih sehingga boleh diimplankan di dalam organ pendengaran. Justeru itu, permintaan terhadap kecekapannya membenarkan pengguna mendengar dengan lebih jelas dan jitu yang semakin tinggi. Peranti bantuan pendengaran perlu disuaikan tahap kelantangan bunyi paling rendah dan paling tinggi mengikut keperluan dan keselesaan individu masing-masing. 2 tahap kelantangan bunyi tersebut ialah had bunyi (HB: tahap di mana bunyi mula didengari) dan tahap paling kuat tetapi selesa (PKS: tahap tertinggi bunyi yang paling selesa).

Jika alat bantu pendengaran disuaikan melebihi tahap PKS pengguna, mereka mungkin akan selalu mengubahsuaikan kawalan bunyi untuk mengurangkan isyarat masukan, maka bunyi yang diterima tidak akan mencukupi dan seterusnya kejelasan percakapan akan terjejas. Ini telah dinyatakan oleh Smoorenburg et. al (2002), iaitu tahap PKS sangat penting untuk disuaikan dengan tepat kerana ianya memberi kesan yang besar kepada kefahaman percakapan jika dibandingkan kepada tahap HB. Tambahan pula, pengguna mungkin akan berisiko kerosakkan sistem pendengaran kerana terlebih tahap PKS (Humes dan Jesteadt, 1991). Kajian telah menunjukkan ramai pengguna peranti bantuan pendengaran tidak puas hati dengan tahap kelantangan alat mendengar mereka (Mueller dan Bentler, 2005) terutamanya tahap PKS.

Sehingga kini, pengukuran skala kelantangan bunyi semasa tetapan alat pendengaran masih dilakukan secara subjektif iaitu penerima peranti bantuan pendengaran perlu menentukan tahap kelantangan bunyi secara lisan setelah stimulus diberikan. Kaedah ini tidak mudah dilakukan terutama sekali untuk menentukan tahap PKS, terutamanya jika penerima tidak dapat memberikan kerjasama sepenuhnya seperti kanak-kanak. PKS ialah tahap yang bersempadan dengan tahap sangat kuat tetapi tidak selesa (SKTS). Tahap SKTS adalah tahap yang tersangat kuat yang tidak mampu didengar pada jangka masa yang lama. Seringkali PKS sengaja dikurangkan pengamatan bunyinya kerana pengguna bimbang akan melangkaui tahap SKTS. Ini mengakibatkan kelantangan bunyi yang dibenarkan oleh peranti berkenaan tidak mencukupi.

Oleh yang demikian pelbagai usaha telah dilakukan untuk membangunkan kaedah menentukan PKS secara objektif. Brown et al. (2000) dan Hughes et al. (2000) telah menunjukkan kolerasi antara had keupayaan tindakan keujaan elektrik dengan HB dan PKS sangat berkesan tetapi tidak kukuh. Potts et. Al (2007) telah menjumpai bahawa had reaksi saraf telemetri boleh menjangkakan kontor HB dan PSK pada elektrod. Walaubagaimanapun, separuh daripada subjek-subjeknya tidak menepati keputusan. Kajian kini mengarah kepada pembangunan kaedah objektif untuk menentukan kelantangan bunyi terutama untuk menentukan tahap PKS. Kajian ini dimulakan oleh Mariam et. al (2009) dan Mariam et. al (2012) yang menunjukkan tindakbalas elektroencephalografi (eeg) iaitu rakaman aktiviti elektrik di lapisan kulit kepala semakin berkurangan apabila keamatan bunyi semakin tinggi. Walaubagaimanapun, keamatan bunyi tidak melambangkan kelantangan bunyi kepada seseorang. Ini adalah kerana setiap orang mempunyai tanggapan terhadap keamatan bunyi yang berbeza. Oleh yang demikian, di dalam kajian ini, hubungan antara bunyi dan kesan penurunan tindakbalas eeg diperincikan kepada tanggapan bunyi tersebut. Seterusnya, kajian ini juga akan mengkaji keberkesanan nada sinus yang berulang untuk membezakan antara tahap PKS dan SKTS.

Kesan ini dikaji diatas komponen gelombang tindakbalas eeg iaitu puncak N100 yang dilaporkan akan meningkat dengan peningkatan perhatian kepada stimuli (Näätänen dan Picton, 1987). Mereka juga melaporkan bahawa N100 mencerminkan ciri-ciri fizikal stimulus seperti keamatan atau kekuatan. Tambahan lagi Soininen at. al (1995) melaporkan bahwa N100 tidak bergantung kepada faktor umur.

KAEDAH KERJA

Subjek-subjek dan Tatacara Ujikaji

10 orang dewasa yang sihat (6 lelaki dan 4 perempuan : purata umur 20 tahun dan 4 bulan dengan sisihan piawai 1 tahun dan 5 bulan) menyertai kajian ini. Ujikaji dijalankan setelah subjek diterangkan akan kaedah ujikaji dengan teliti dan menandatangai borang kebenaran. Kesemua subjek-subjek tidak mempunyai sejarah masalah pendengaran dengan aras pendengaran (bawah 15 desibel (dB)). Setiap subjek menerima ujian audiogram sebelum dan selepas ujikaji untuk memastikan tiada kesan sampingan. Stimulus yang digunakan ialah 1000 Hz nada sinus sepanjang 50 milisaat. Nada ini diberikan secara ulangan setiap 1 saat. Stimulus dijanakan dengan komputer dan didengarkan pada telinga kanan.

Untuk mendapatkan tahap tanggapan kelantangan bunyi SEDERHANA, PSK dan SKTS, ukuran subjektif dilakukan sebelum ujikaji. Untuk itu nada sinus diperdengarkan kepada subjek dengan keamatan bunyi daripada 10 dB sehingga 90 dB secara rawak. Subjek diminta untuk mengkelaskan kelantangan bunyi tersebut dengan menunjukkan skala kelantangan bunyi Pascoe seperti yang ditunjukkan pada rajah 1. Untuk rakaman eeg, stimulus-stimulus diperdengarkan kepada subjek pada tahap kelantangan SEDERHANA, PKS dan SKTS secara berasingan dengan 3 minit rehat di antara pengukuran. Ujikaji ini mengambil masa selama 1 jam termasuk persediaan subjek. Rakaman eeg dilakukan di dalam bilik yang kalis bunyi. Subjek ditempatkan di atas kerusi rekliner mengikut keselesaan mereka. Subjek diminta supaya sentiasa berasa tenang dan selesa dengan mata sentiasa tertutup dan tidak melakukan pergerakkan yang besar disepanjang ujikaji. Walaubagaimanapun, mereka tidak dibenarkan untuk tidur. Untuk itu, subjek sentiasa dipantau untuk mengawasi tanda-tanda tidur seperti berdengkur atau pergerakkan mata pantas. Jika, subjek didapati tidur, bacaan ukuran akan dibuang. Eeg dirakam dengan dengan menggunakan sistem BIOPAC Inc, MP150 EEG 100C dan perisian komputer (Acknowledge 4.2). Elektrod permukaan (Ag/AgCl) diletakkan di sebelah kanan mastoid, di vertex dan atas dahi. Impedan dipastikan sentiasa di bawah 5 kΩ.

Pembahagian Data

Stimulus akan diulangi sebanyak 200 kali untuk setiap tahap kelantangan bunyi. Eeg akan dipotong diantara 1 kepada 800 milisaat selepas stimulus. Setiap potongan eeg ini akan dirujuk sebagai tindakbalas disepanjang kertas kerja ini. Tindakbalas-tindakbalas ini akan ditapis menggunakan penapis jalur lebar 1-30Hz.

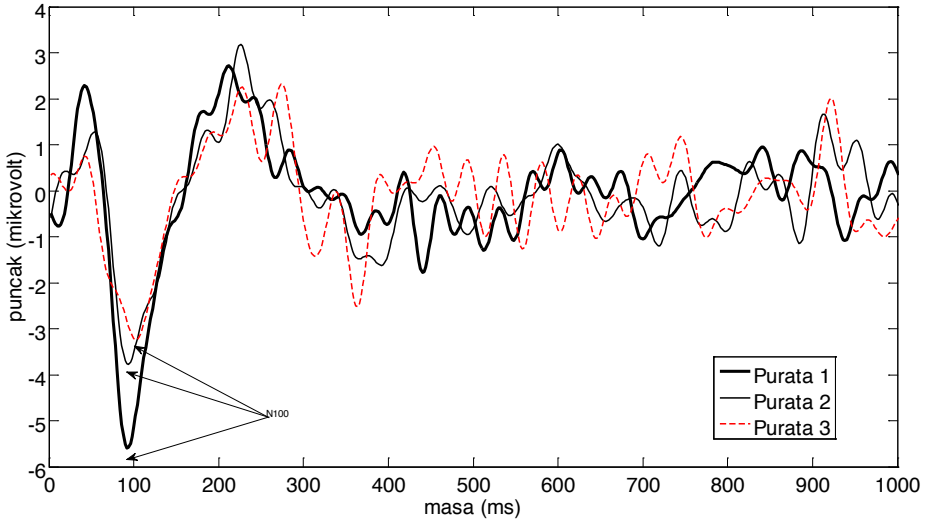
Rajah 1: Skala kelantangan bunyi Pascoe

HASIL KEPUTUSAN

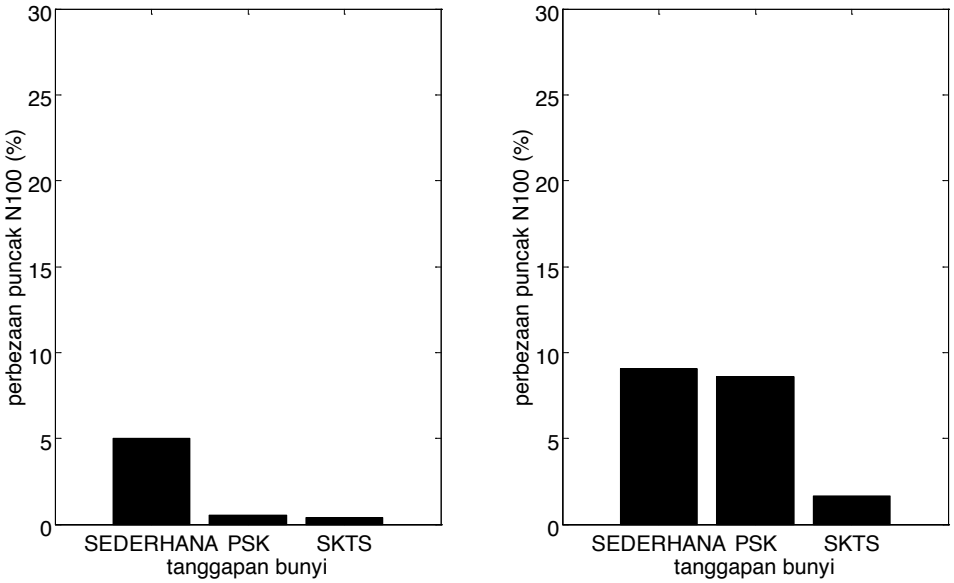
Untuk menganalisa puncak N100 pada tindakbalas yang direkodkan, tindakbalas-tindakbalas ini dipuratakan seperti yang ditunjukkan pada Rajah 2. Keadah ini adalah untuk mengurangkan nisbah isyarat terhadap hingar dan seterusnya mempamerkan komponen N100 dengan jelas. Biarkan set A = $\{x_i : i = 1, 2, \ldots, N\}$, iaitu N ialah jumlah tindakbalas-tindakbalas yang direkodkan pada satu-satu tahap stimulasi. Untuk menghasilkan puncak N100 yang jelas seperti yang ditunjukkan pada Rajah 2, tindakbalas set A akan dipuratakan untuk setiap 5 tindakbalas. Purata 1 adalah hasil purata set A= $\{x_i : i = 1, 2, \ldots, 5)$, Purata 2 adalah hasil purata set A= $\{x_i : i = 6, 7, \ldots, 10)$, dan Purata 3 adalah hasil purata set A= $\{x_i : i = 11, 12, \ldots, 15)$. Jelas dilihat puncak N100 Purata 1, Purata 2 dan Purata 3 berkurangan terhadap stimulasi. Bagi kes ini (subjek 1 pada tahap stimulasi sederhana), diperhatikan bahawa puncak N100 tindakbalas terus berkurangan disepanjang ujikaji.

Penilaian dilakukan dengan membezakan purata puncak N100 separuh awal dengan separuh akhir ujikaji ($[B= \{Purata_i : i = 1, 2, \ldots, M/2\}] - [C= \{Purata_i : i = M/2, M/2+1, \ldots, M\}]$ iaitu M ialah jumlah purata yang terhasil. Rajah 3 sehingga Rajah 7 menunjukkan peratus perbezaan puncak N100 bagi setiap subjek pada semua tahap stimulasi. Diperhatikan bahawa setiap subjek menunjukkan penurunan perbezaan puncak apabila tanggapan bunyi semakin kuat. Secara puratanya, kesemua subjek menunjukkan penurunan puncak sebanyak 12.33 % dengan sisihan piawai (std) 8.39 apabila distimulasikan dengan tahap SEDERHANA. Manakala pada tahap PKS, penurunan puncak berkurang kepada 7.52 % dengan std=6.74. Pengurangan peratus perbezaan puncak lebih menurun pada tahap SKTS iaitu 1.95 % dengan std 2.55 secara puratanya. Jadual 1

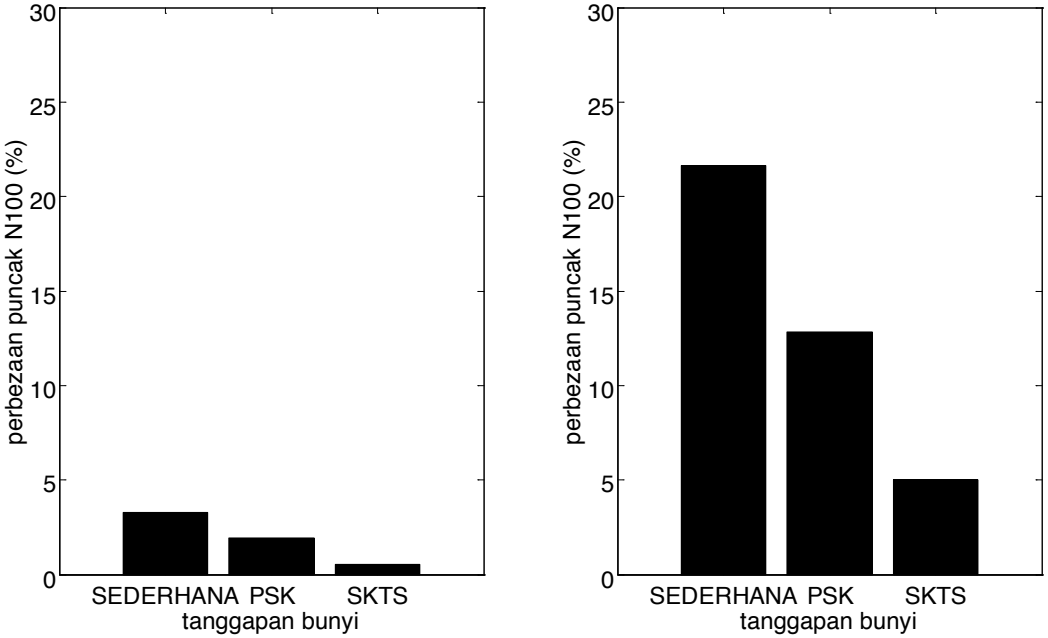
menunjukkan keputusan ujian statistik Mann–Whitney U-Ujian (tahap keberkesanan $p<0.05$), menunjukkan peratus perbezaan N100 puncak diantara setiap subjek tidak berbeza pada stimulasi masing-masing walaupun std besar.



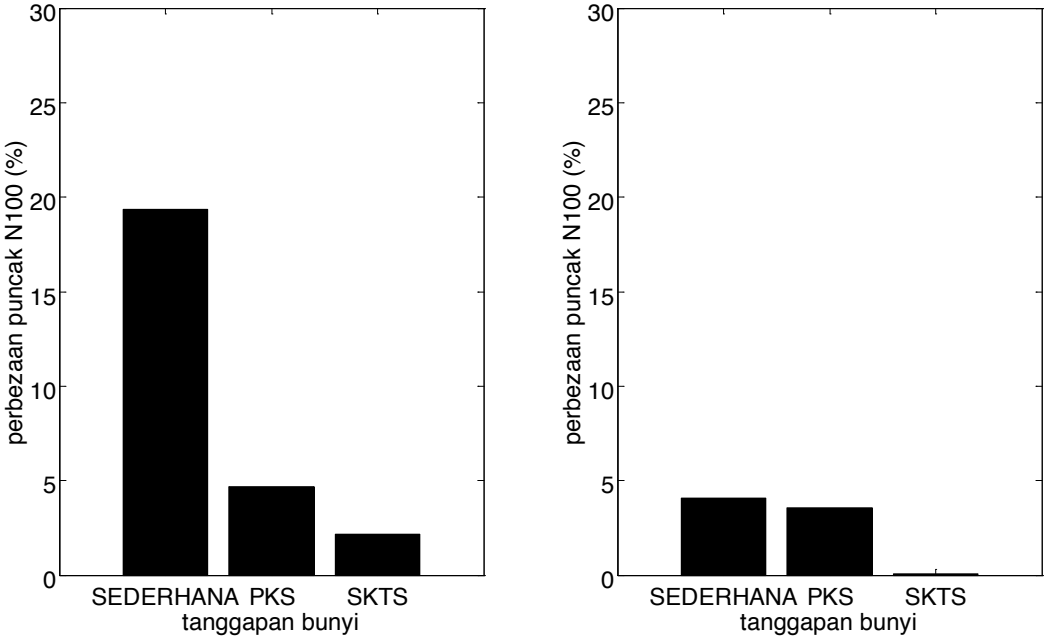
Rajah 2: Gelombang eeg yang telah dipotong akan dipuratakan pada setiap 5 gelombang. Purata 1 ialah hasil purata tindakbalas 1 sehingga 5, Purata 2 ialah hasil purata tindakbalas 6 sehingga 10 dan Purata 3 ialah hasil purata tindakbalas 11 sehingga 15. Dapat dilihat, puncak N100 Purata 1 lebih negatif berbanding Purata 2 dan 3.



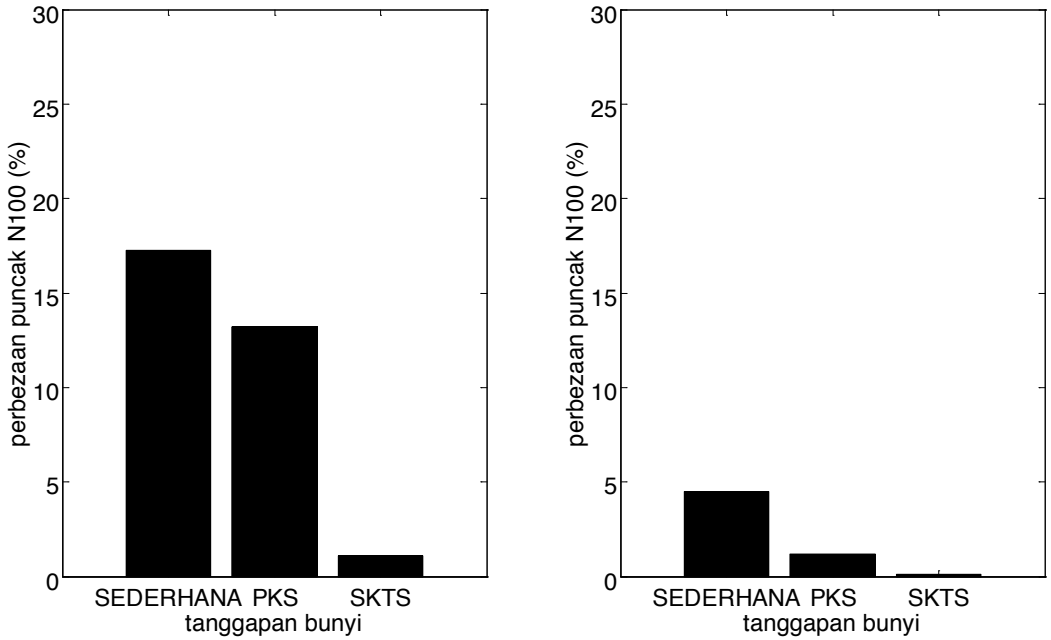
Rajah 3: Menunjukkan graf peratusan perbezaan puncak N100 terhadap tanggapan bunyi bagi subjek 1 (kiri) dan subjek 2 (kanan). Didapati semakin tinggi kelantangan bunyi semakin rendah penurunan puncak N100.



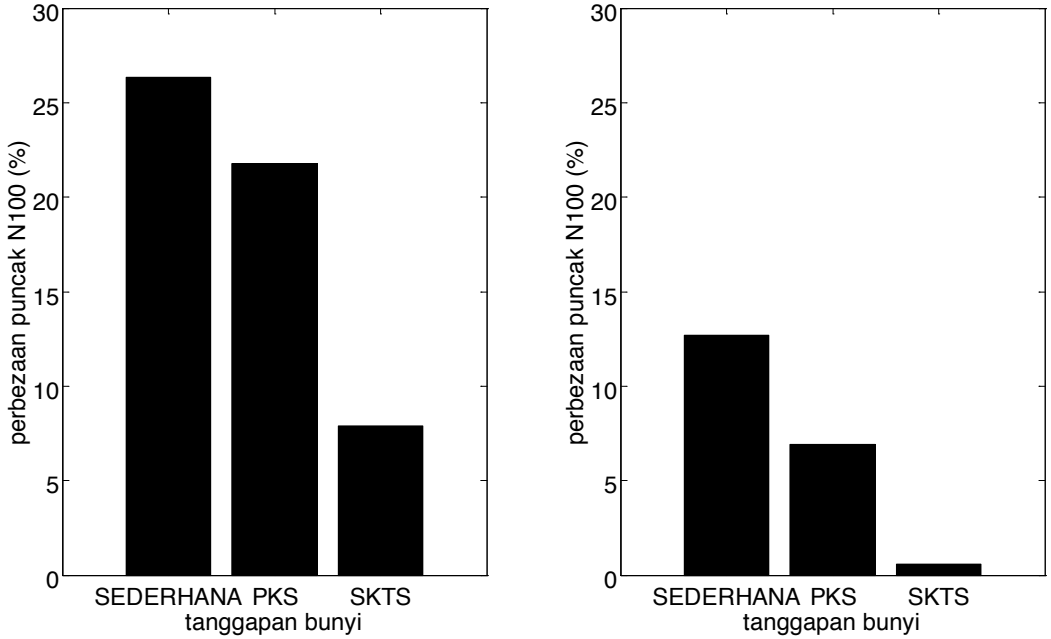
Rajah 4: Menunjukkan graf peratusan perbezaan puncak N100 terhadap tanggapan bunyi bagi subjek 3 (kiri) dan subjek 4 (kanan). Didapati semakin tinggi kelantangan bunyi semakin rendah penurunan puncak N100.



Rajah 5: Menunjukkan graf peratusan perbezaan puncak N100 terhadap tanggapan bunyi bagi subjek 5 (kiri) dan subjek 6 (kanan). Didapati semakin tinggi kelantangan bunyi semakin rendah penurunan puncak N100.



Rajah 6: Menunjukkan graf peratusan perbezaan puncak N100 terhadap tanggapan bunyi bagi subjek 7 (kiri) dan subjek 8 (kanan). Didapati semakin tinggi kelantangan bunyi semakin rendah penurunan puncak N100.



Rajah 7: Menunjukkan graf peratusan perbezaan puncak N100 terhadap tanggapan bunyi bagi subjek 9 (kiri) dan subjek 10 (kanan). Didapati semakin tinggi kelantangan bunyi semakin rendah penurunan puncak N100.

Jadual 1: p-Nilai Mann-Whitney U-Ujian (tahap keberkesanan $p<0.05$) untuk tahap sederhana, PKS dan SKTS terhadap kesemua subjek-subjek.

Persepsi	p-Nilai
SEDERHANA	1
PKS	0.55
SKTS	0.55

PERBINCANGAN DAN KESIMPULAN

Di dalam kajian ini, perhubungan di antara darjah penurunan puncak N100 dengan tanggapan bunyi dikaji. Berdasarkan kepada kajian-kajian sebelum ini, stimulasi berterusan akan mengakibatkan puncak N100 berkurangan (Öhman dan Lader, 1972), (Özesmi et. al, 2000) dan (Fruhstofer et. al, 1970). Walaubagaimanapun, Öhman dan Lader (1972) dan Mariam et. al (2009), telah menunjukkan bahawa keamatan bunyi yang tinggi gagal menunjukkan penurunan puncak yang berkesan. Walaubagaimanapun keamatan bunyi tidak melambangkan kelantangan bunyi yang didengari oleh seseorang. Berdasarkan penilaian subjektif yang dilakukan oleh Mariam et. al (2012) didapati tahap tanggapan bunyi diantara individu dengan individu yang lain sangat besar perbezaannya. Oleh yang demikian, didalam kajian ini, gelombang eeg direkodkan pada tahap tanggapan bunyi, bukan berdasarkan keamatan bunyi. Untuk mendapatkan penilaian tanggapan bunyi yang tepat dan boleh dipercayai, subjek-subjek dipilih dikalangan yang mempunyai pendengaran yang normal.

Tujuan utama kajian ini ialah membezakan antara tahap persepsi PKS dan SKTS. Untuk itu, tiga tahap tanggapan bunyi daripada jadual skala kelantangan bunyi iaitu SEDERHANA, PKS dan SKTS telah dikaji. Tahap SEDERHANA digunakan sebagai bacaan kawalan. Menentukan tahap SKTS adalah sangat mudah kerana ianya ialah tahap yang terlampau kuat dan tidak mampu diterima oleh seseorang pada masa yang lama. Tetapi untuk menentukan PSK adalah sangat sukar. Ini adalah kerana PSK sering kali disalah tafsirkan sebagai SKTS, seterusnya pengguna peranti bantuan pendengaran akan merendahkan penala bunyi dan mengakibatkan tahap pendengaran yang telah disuaikan kepada peranti tersebut tidak mencukupi. Seperti yang dibincangkan pada bahagian pengenalan, PKS penting untuk ditentukan dengan tepat untuk mencapai tahap perkembangan kemampuan bercakap yang baik khususnya penerima implan koklear kanak-kanak.

Berdasarkan hasil keputusan yang diperolehi, PKS dan SKTS dapat dibezakan dengan menggunakan kaedah yang dicadangkan. Jika nilai purata penurunan puncak diambil sebagai penanda aras setiap tanggapan bunyi, didapati 7 daripada 10 subjek menunjukkan penurunan puncak N100 bagi tahap stimulasi SKTS tidak melebihi 1.95%. maka boleh dicadangkan bahawa apabila penurunan puncak N100 tidak kekal pada tahap 1.95% semasa pengukuran, bermakna tahap stimulasi sudah mencapai SKTS. Walaubagaimanapun, jika dilihat secara individu, 3 daripada 10 subjek ini mempunyai penurunan puncak yang sangat tinggi pada tahap SEDERHANA. Oleh yang demikian, boleh dikatakan bahawa kemungkinan individu-individu ini mempunyai tahap kemampuan mengendahkan sesuatu stimulus dengan sangat mendalam

dan seterusnya mengakibatkan penurunan puncak melebihi 5% walaupun pada tahap SKTS. Namun begitu masih juga jauh lebih rendah berbanding tahap SEDERHANA dengan berkesan. Bagi tahap PKS, jika diambil nilai purata 7.52% sebagai penanda aras atas dan 1.95% sebagai penanda aras bawah, 4 daripada 10 mungkin disalah tafsirkan sebagai SEDERNAHA dan 2 subjek lain akan dianggap sebagai SKTS. Walaubagaimanapun, penilaian individu menunjukkan bahawa paras PKS tidak melebihi paras SEDERHANA dan kurang daripada SKTS secara berkesan (Ujian statistik Mann–Whitney U-Ujian (tahap keberkesanan $p<0.05$)).

Daripada keputusan-keputusan yang diperolehi, masih terlalu awal untuk menyatakan nilai peratusan penurunan puncak N100 bagi menentukan tahap SKTS dan PKS dengan secara tepat kerana jumlah sampel yang diambil kecil. Nilai peratusan penurunan puncak ini boleh dicapai dengan mendapatkan sampel yang besar pada masa akan datang. Namun begitu, satu bentuk perhubungan antara penurunan puncak N100 dan tanggapan bunyi telah dilihat di dalam kajian ini. Kaedah yang dicadangkan di dalam kajian ini boleh digunakan sebagai asas untuk membangunkan satu prosedur bagi proses aturan tahap bunyi bagi pengguna implan koklear dan peranti bantuan pendengaran.

Kajian terhadap penurunan puncak N100 terhadap kelantangan bunyi, bukan sahaja untuk platform penyediaan prosedur yang objektif bagi menentukan skala kelantangan bunyi tetapi juga boleh digunakan untuk mengkaji tahap kesedaran dan perhatian untuk pendidikan dan keselamatan pemanduan.

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Mai Mariam Mohamed Aminuddin
Izadora Mustaffa
Hairulisam Md Dom
Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka.
Tel : 06-5552156
Fax: 06-5552121

20

GPS and GPRS Based Cost Effective Human Tracking System Using Mobile Phones for Government Servant Field Work Movement

Azlan Mohamed, Mohd Fikrie Shahid, Azizan Asmuni,
Ismi Arif Ismail & Azahari Ismail

ABSTRACT

This paperwork presents a low cost human tracking system using GPRS GPS on GSM network. The combination of both the technologies i.e. GPS and GPRS provides a constant, continuous and real time human tracking system. The cost of the overall system has been reduced by two facts one is using the existing mobile phone and another is using GPRS instead SMS. It has been hoped that the use of the overall system can eliminate the requirement of first the traditional GPS receivers and second costly SMS based tracking systems. The main proposal here is to enhance the super quality supervision between subordinate that work at field area and management level at head office. This presentation also to encounter the major problem to the top level management to manage their field worker. The system which is introduce will able to track down the worker at the real time, real based job and fully monitoring at real time based. As far as head management concern that it is veriew crucial that to monitor all the subordinate at field.This is because some of the subordinate not fully utized the time given to finish and complete their work as per requested. The methodology used by the presenter are using observation ,experience,data sampling, information research on product and their usefulness to meet the demand in market.As we can concluded the future scope of this such of system had a massive field of usefulness which not only benefit to one particular field but also can stretch to others usefulness.

Keyword : GPS, GPRS , Supervision, Government

ABSTRAK

Kertas kerja ini adalah untuk pengesanan manusia/pekerja dengan menggunakan system "Pengesanan secara global "(GPS)/"pengesanan secara radar melalui Satelit".(GPRS)Sistem dan peralatan yang digunakan adalahsecara tetap/malar ,berterusan dan menggunakan masa sebenar dan bukan masa yang tertunggak.Kos –kos yang terlibat adalah jauh lebih rendah adalah disebabkan system dan peralatan yang ada adalah daripada internet yang boleh didapati secara percuma atau berbayar berbanding sistem pesanan ringkas (SMS).Adalah diharapkan secara keselurannya sistem ini dapat memansuhkan sistem yang menggunakan sistem GPS lama dan kos yang tinggi berbanding kos pesanan ringkas. Tujuan utama kertas cadangan ini adalah untuk meningkatkan lagi kualiti pengawasan yang lebih baik diantara pihak atasa dan pekerja jabatan yang bekerja di lapangan.Tujuan lain juga adalah untuk memastikan semua masalah utama pihak pengurusan atasan terhadap pekerj alpangan dapat diatasi.Sistem yang diperkenalkan ini adalah untuk mengenalpasti dan mengesan kedudukan lokasi pekerja lapangan yang membuat kerja lapangan pada masa sebenar ,kerja yang sedang dilakukan dan pengawasan dari

pihak pengurusan pada masa itu walaupun kerja lapangan yang dilakukan adalah diluar kawasan. Adalah menjadi satu masalah besar pada pihak organisasi untuk memastikan dan mengawasi semua pekerja lapangan,ini adalah kerana ada didapati pekerja lapangan yang tidak megoptimumkan masa yang diberi untuk melakukan pada masa yang ditetapkan dan kerja yang sepatutnya diselesaikan. Method yang digunakan adalah melalui pemerhatian,pengalaman ,contoh-contoh data,pengkajian maklumat dalam produk serta keperluan permintaan di dalam pasaran.Boleh disimpulkan bahawa skop pada masa hadapan untuk alat dan sistem ini bukanlah untuk satu bidang sahaja tetapi boleh juga digunakan dalam pelbagai bidang lain.

Kata Kunci : GPS, GPRS, Penyeliaan, Kerajaan

INTRODUCTION

The main proposal here is to enhance the super quality supervision between subordinate that work at field area and management level at head office. This presentation also to encounter the major problem to the top level management to manage their field worker. The system which is introduce will able to track down the worker at the real time ,real based job and fully monitoring at real time based.

As far as head management concern that it is veriew crucial that to monitor all the subordinate at field.This is because some of the subordinate not fully utized the time given to finish and complete their work as per requested.

PROBLEM STATEMENT

Less law enforcement and top management is the lack of knowledge and understanding regarding subordinate movement. which highlights the need for effective case management .As far as concern the law enforcement is lack due to misunderstanding that the law of enforcement just only for heavy misconduct.

Availability of Supervision. As one top level said the instruction been given to all subordinate to follow the order. The job task must be complete at the specific time at the specific job. The report must be deliver due to the completeness of the job. The problem occur when the job done but took a long hours and longer period.

Appropriateness of job task. Some job only finish at the time given. However the the appropriateness of the job task always been a question. This is happen when the same mistake or faulty at the same problem. The supervision take place only when the problem become to heavy to handle.

Access to report. The workers indicate that the availability of information and access to the report after a quite sometime. The problem is the corrective action or the report must take place as soon as possible to avid same mistake occur.

Length of Job Done. Another challenge identified by head office is the length or duration of the length of job done by the workers ,they note that the timeline varies by different workers.

That's why the solution must be identified the capability of the different workers to solve the same works must equally measured.

Lack of Coordination of Services. For the most part, top management acknowledge improved coordination of by year to year .However, they see the need for a single point of contact within each worker to monitor and effective supervision..

LITERATURE REVIEW

Group Supervision

Merits of group supervision

A practitioner's learning and continued development typically is fostered through concurrent use of individual and group supervision. Group supervision is unique in that growth is aided by the interactions occurring among group members. Care workers and counselors do not function in isolation, so the group becomes a natural format to accomplish professional socialization and to increase learning in a setting that allows an experience to touch many. Supervision in groups provides an opportunity for supervisees to experience mutual support, share common experiences, solve complex tasks, learn new behaviors, participate in skills training, increase interpersonal competencies, and increase insight (MacKenzie, 1990). The core of group supervision is the interaction of the supervisees.

Collaborative learning is a pivotal benefit, with the supervisees having opportunities to be exposed to a variety of cases, interventions, and approaches to problem solving in the group (Hillerband, 1989). By viewing and being viewed, actively giving and receiving feedback, the supervisee's opportunities for experimental learning are expanded; this characterizes group supervision as a social modeling experience. From a relationship perspective, group supervision provides an atmosphere in which the supervisee learns to interact with peers in a way that encourages self-responsibility and increases mutuality between supervisor and supervisee.
Groups allow members to be exposed to the cognitive process of other counselors at various levels of development (Hillerband, 1989). This exposure is important for the supervisee who learns by observing as well as speaking. Finally, hearing the success and the frustrations of colleagues gives the supervisee a more realistic model by which they can critique themselves and build confidence.

Models of group supervision

Bernard and Goodyear (1992) summarized the typical foci of group supervision: didactic presentations, case conceptualization, individual development, group development, organization issues, and supervisor/supervisee issues. Models for conducting group supervision detail experiential affective approaches designed to increase the supervisees' self-concept and ability to relate to others, and/or cognitively focused activities, such as presenting cases which broaden the practitioner's ability to conceptualize and problem-solve. While the literature provides information on how to conduct these activities, less obvious are the reasons why certain activities are selected and when the activities are most appropriate to use.

Borders (1991) offered a model that details reasons with the suggested activities. Groups may be used to increase feedback among peers through a structured format and assignment of

roles (e.g., client, counselor, and other significant persons in client's life) while reviewing tapes of supervisees interventions and sessions. "Role-taking" encourages supervisees to assume more responsibility in the group as feedback is offered from several viewpoints.
Models provide almost no attention to how the supervisor is to make judgments about the use of "group process." The supervisor has little guidance about how to use the collective nature of the group to foster worker development.

Similarly, the development of the group has not been the focus of researchers -- only a few empirical studies have been conducted to examine group supervision. Holloway and Johnston (1985), in a review of group supervision literature from 1967 to 1983, suggested that peer review, peer feedback, and personal insight are all possible to achieve while doing supervision in groups. Focus on the development of the group is not apparent in these studies, yet the term "group supervision" is defined with an emphasis on the use of group process to enhance learning.

Group supervision process

As above indicates, the group supervision format requires that supervisors be prepared to use their knowledge of group process, although how this is to be done is very unclear. A recent naturalistic study of four groups across one semester provided some initial insights. Werstlein (1994) found that guidance and self-understanding were cited by supervisor and supervisees as the most important "therapeutic factors" (Yalom, 1985) present in their group. In addition, the initial stages of group development were apparent. Less noticeable were the later stages of group development which are characterized by higher risk behaviors that increase learning (Werstlein, 1994). Clearly, additional work is needed to clarify the process variables of group supervision and the role of the group leader (supervisor).

Supervisor as group leader

Based on existing group supervision literature and small group literature, the following guidelines are offered to supervisors who wish to address process in group supervision:

1. Five to eight supervisees meeting weekly for at least one and one half hours over a designated period of time (i.e., office meting) provides an opportunity for the group to develop.
2. Composition of the supervision group needs to be an intentional decision made to include some commonalities and diversities among the supervisees (i.e., supervisee developmental level, experience level, or interpersonal compatibility).
3. A pre-planned structure is needed to detail a procedure for how time will be used and provide an intentional focus on content and process issues. This structure can be modified later in accordance with group's climate.
4. A pre-group session with supervisees can be used to "spell-out" expectations and detail the degree of structure. This session sets the stage for forming a group norm of self-responsibility and does not interfere with group development.
5. Supervisors may use "perceptual checks" to summarize and reflect what appear to be occurring in the here-and-now in the group. Validating observations with the supervisees is using process. Be active, monitor the number of issues, use acknowledgements, and involve all members.

6. Supervisees' significant experiences may be the result of peer interaction that involves feedback, support, and encouragement (Benshoff, 1992). Exploring struggles supports learning and problem-solving.
7. Bernard and Goodyear (1992) provided an excellent overview of the group supervision literature. Many ideas are available for structuring case presentations and the entire group sessions. Also, reviewing materials on group facilitation with a particular focus on dealing with process is essential.
8. Competition is a natural part of the group experience. Acknowledge its existence and frame the energy in a positive manner that fosters creativity and spontaneity.

In preparation for group supervision, communicate the following to the supervisees about how to use group process:

1. Learning increases as your listening and verbal involvement increases. Take risks and reveal your responses and thoughts.
2. Decrease your personalization of frustration by sharing with your peers. You will be surprised how often other supervisees are experiencing the same thoughts and feelings.
3. Intentionally look for similarities as you contemplate the relationships you have with your peers in the group with the relationships you are having with clients. Discuss similarities and differences.
4. Progress from client dynamics to practitioner dynamics as you present your case. Know ahead of time what you want as a focus for feedback and ask directly.

BACKGROUND RESEARCH

Through the supervision the proposal explain that the potential of the tracking device nowadays is depending on the job scope and the beneficial to the organization itself. As per daily used human tracking been used just only indoor management .The large organization normally monitor and track their workers inside the building by using the RFID tag .This tag are common practice to track down the movement of the workers inside the building. It's can be said the market of the new technology and tracking devices is always in high demand. Indoor and outdoor market always at peak. Various service or field based company will see that this devices is a solution in solving the efficiency of their workers.

The case scenario : Martha Stewart wears an ankle bracelet, Sprint announces a new "Business Mobility Framework" for employer to track employees. Already school at Osaka Japan, are required to wear similar tags tucked in their belongings. The government of Mexico tracks court officials with the radio frequency identification (RFID) tags implemented in their shoulders. Finland changes nationals laws to allow cell phone tracking of children. (sources : www.directionmag.com/articles/human-tracking-goes-mainstream/123424)

Even at our country nowadays express bus under Scania equipped with GPS tracking system to locate their bus during daily operation. Bus Operator SANI EXPRESS Sdn Bhd KM 20.7 Karak Highway towards Gombak toll Selangor 25 Mei, 2011 5.30 am .Bus operator claimed that the company head office at Kota Bahru alert the accident through the GPS that equipped in the bus. This give opportunity to the company take the fastest action to call and informed emergency authority to give their best action.

From the case study it can be said that the market for human tracking devices is ready and the organization are keen to see forward this such of technology .

PROPOSAL SOLUTION

The device and system should be Managing and developing people – Organization today want some direction and structure, but they also want freedom and encouragement to develop their workers skills and knowledge. Effectively managing people requires balancing constraining forces (providing direction, structure, organization, some rules) with liberating forces (encourage personal growth, development and creativity).. Effective system is needed to manage all people the same to do the right task at the right time. So the time constraint can be manageable and avoid the time waste. They manage each person according to what he or she needs, what motivates them to do their best. This can be complicated but the system offer should be part of success.

Organization should have Strategic focus - In today's rapidly changing world, it's not just enough to have a purpose for existing. The organization's human resources on the greatest challenges , which shift with each new day.. So it's necessary for organization to keep focused on the desired end results such as increased job performances or more satisfied customers. This device will alert the workers ensure the job done at the specific time at right method to ensure optimum performance.

Operations, or what people do all day - What the people in organization do day in and day out to create value for customers. But how to monitor? .Effective operations ensure that customers get exactly what they want at the right time, the right price and the right quality. Thus effective operations management focuses on what is called cycle time (producing a product or service from start to finish), cost control, and quality control (which requires some form of measurement). Strategic focus is largely externally oriented, operations largely internally oriented. Both need to be totally in sync with each other – not something that happens automatically but rather requiring constant effort. This is why communication is the true lifeblood of a successful organization – a high flow of information so everyone and everything is connected. Easy to say, hard to do.so this is the one who create some additional market for our company.

Physical resources - Finances, facilities, human resources management and equipment are the big 4 physical resources. If organization doesn't have enough money, they can't start or sustain an organization. And one of the biggest expenses is providing adequate facilities and equipment for people to work in and with.. Likewise nice facilities and good managing staff can be energizing, something to feel proud about, but also very expensive. So with the strategic equipment, some of obstacle can be avoid.

Customer relations - Customers are where the money comes from, so in many always this is the most important success factor. As the famous business guru Peter Drucker said years ago, The purpose of a business is to get and keep customers. Getting customers involves marketing – indeed this success factor includes all kinds of marketing and sales. The key to successful customer

relations is to give them what they need, not just what we want to sell. To give the satisfaction to the customer is major factor to us.

Project Description Proposal As Solution

The main purpose of this is tracking for :

- GPS enabled Mobile Phones
- GPS Micro Tracker Devices

The company provider"TrackOne" samples the Device's position every a defined period of timeline ,example 1 minute and stores the position. The position will become reference to the management operator to know and identified whichever the device owner location.

The organization can :

- Access the Position Records by Web querying by windows of time and receiving
    1. Trajectory maps by Google Earth
    2. Tables exportable to Excel or several standard formats

- Define Alarms raised SMS and email to be triggered by
    1. Expected Times and Position not complied
    2. Speed Limits
    3. Geofences
    4. Lack of connectivity to the service
    5. Lack of GPS position

The features of device and system enable the organization :

- Global Scope ,anyone can enroll and roam freely
- Mobile Operator independent, no special deals needed
- Mobile Phone independent, covering Blackberry, and soon Nokia, Motorolla, Etc
- Personal Customer can self enroll by web
- Easy Installation
    1. On mobile phones,the customer downloads Over The Air by Push SMS the Mobile Application,Worldwide
    2. On Micro Trackers,TrackOne initializes and configures automatically the devices by SMS
- Has a built in Distributors and Sales Channels management system in order to sell to OEM and by channels.
- Corporate Customers and organization have a suite of web tools that allow to manage vehicles fleets, personnel on the streets and Logistics
- No capex or Opex needed from the organization, they just buy the Devices and phones lines and pay for the Services Provider

CONCLUSION

The needs of devices and system of human trafficking, whether international or domestic, can be characterized as complex, requiring comprehensive services and treatment that span a continue

of care from emergency to short-term to longer-term assistance. Providing these services can take months or years; the timeline for serving each client is different and often unpredictable. The challenges associated with accessing timely and appropriate services for victims are ongoing. But through collaboration among agencies, including non-governmental organizations, shelter providers, health care providers, law enforcement and others in communities across the country, and through innovative strategies and promising practices, there are more services available today for devices and system of human trafficking than at any time in the past. And while there remains room for improvement. The services available for company for human trafficking appear to be better tailored to their needs than they have been in the past.

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Azlan Mohamed
Universiti Putra Malaysia
Neo_azlanisme@yahoo.com

Mohd Fikrie Shahid
Universiti Tekonologi MARA
fikrishahid@gmail.com

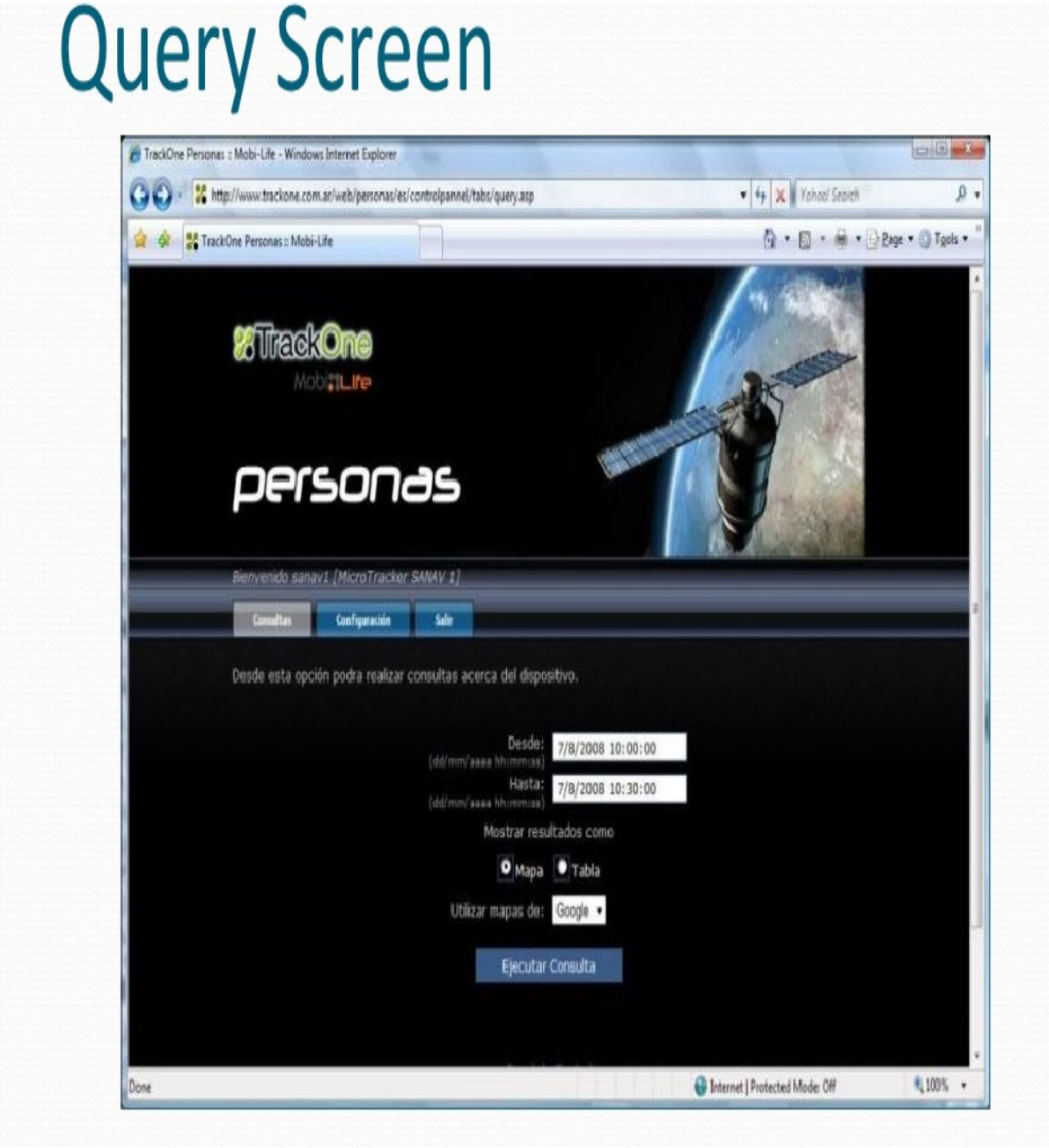
Prof Madya Dr Azizan Asmuni
Prof Madya Dr Ismi Arif Ismail
Prof Madya Dr Azahari Ismail
Universiti Putra Malaysia

APPENDIX

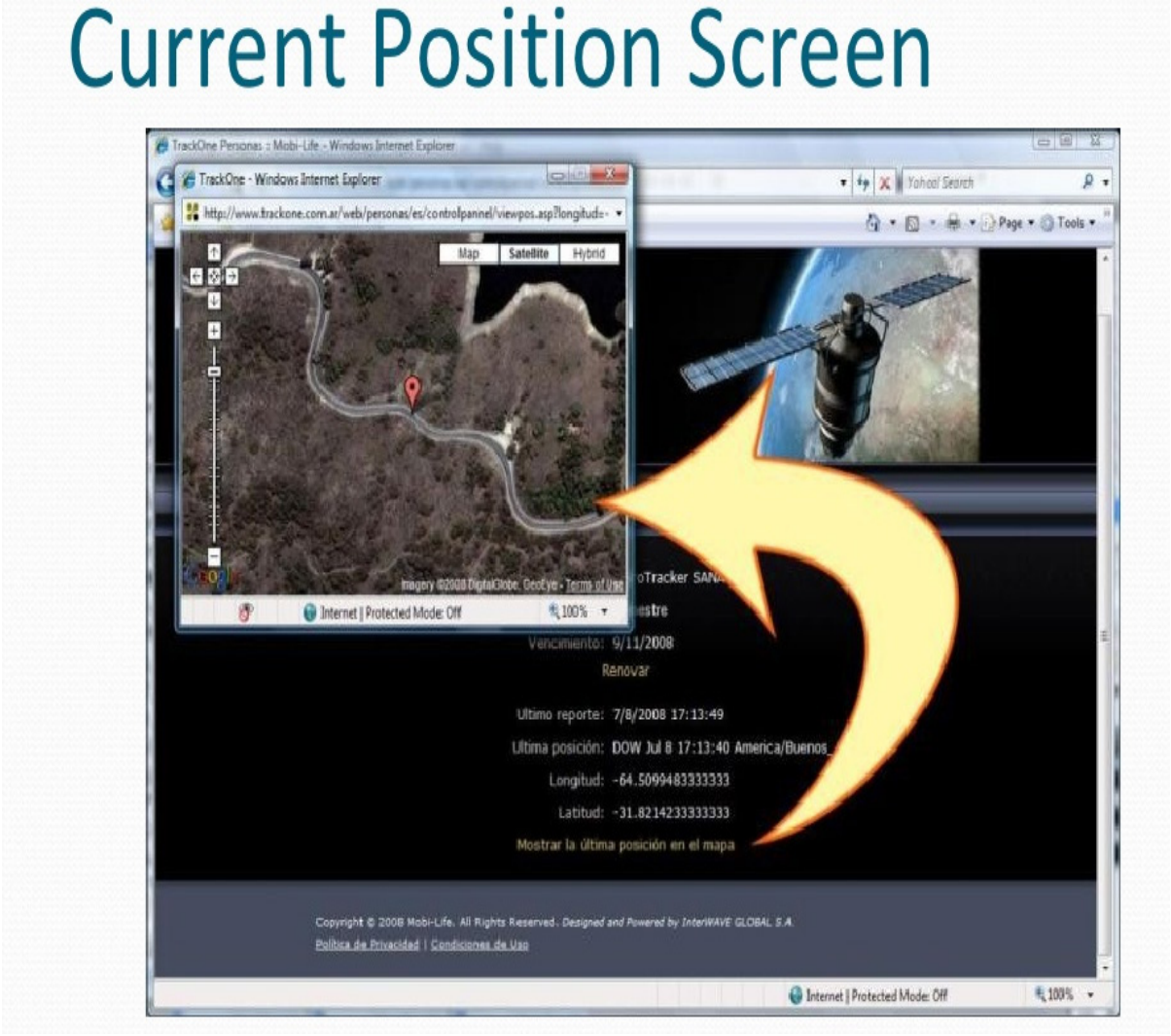
Description of Technology

It is global services model whereby the product will used to track down human by using smart phone.

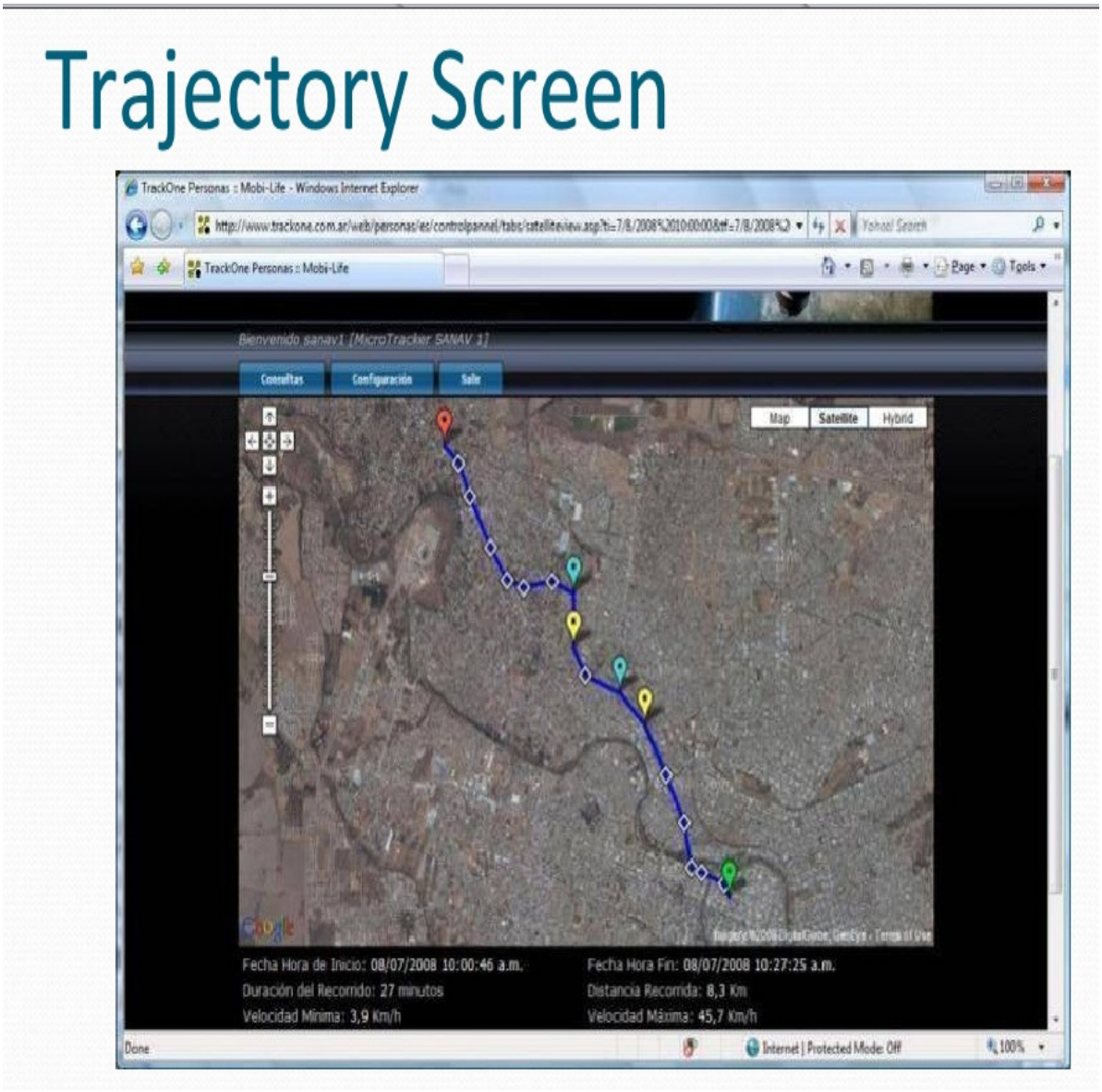
Query Screen



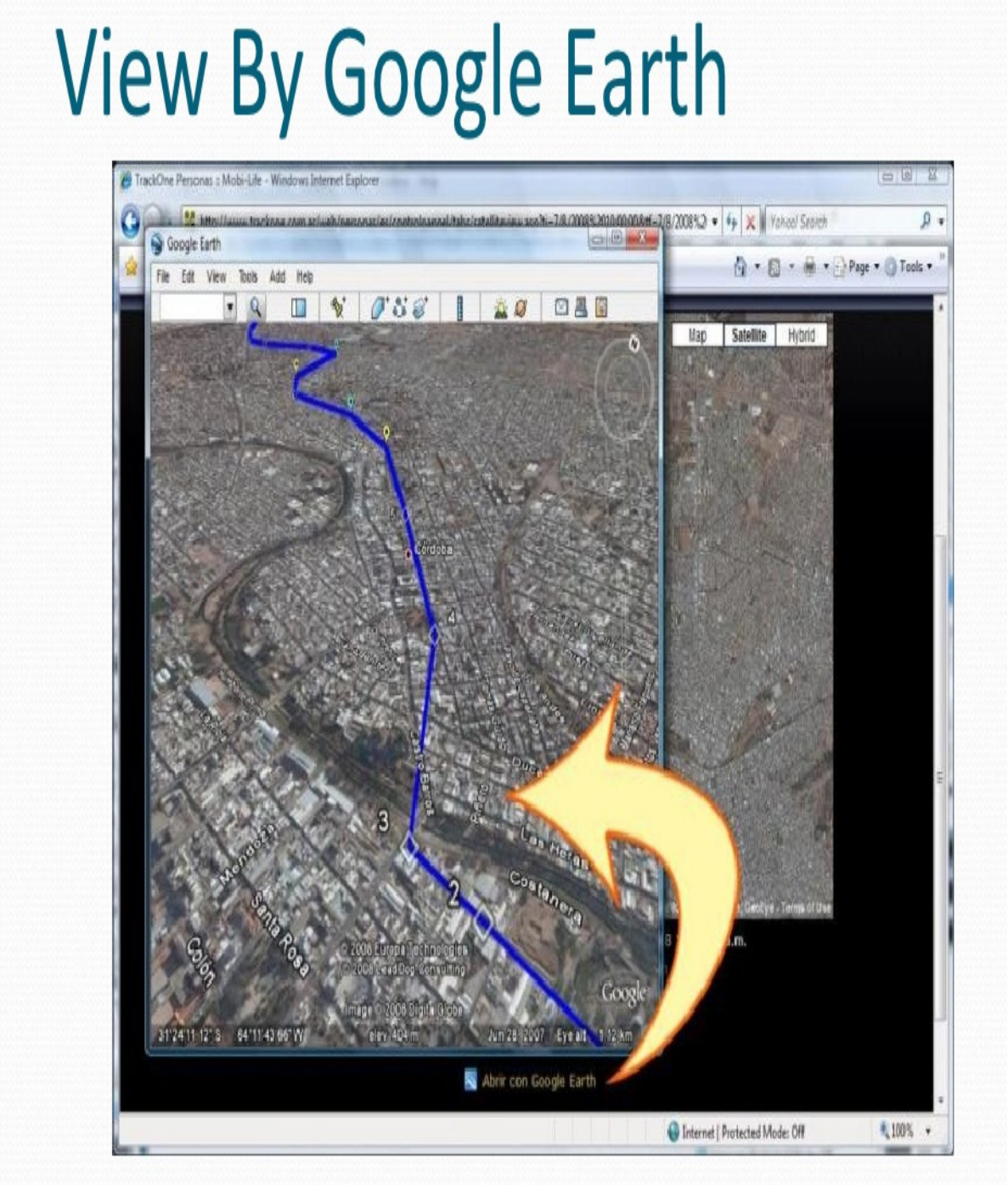
Current Position Screen



Trajectory's Spot Detail



View By Google Earth



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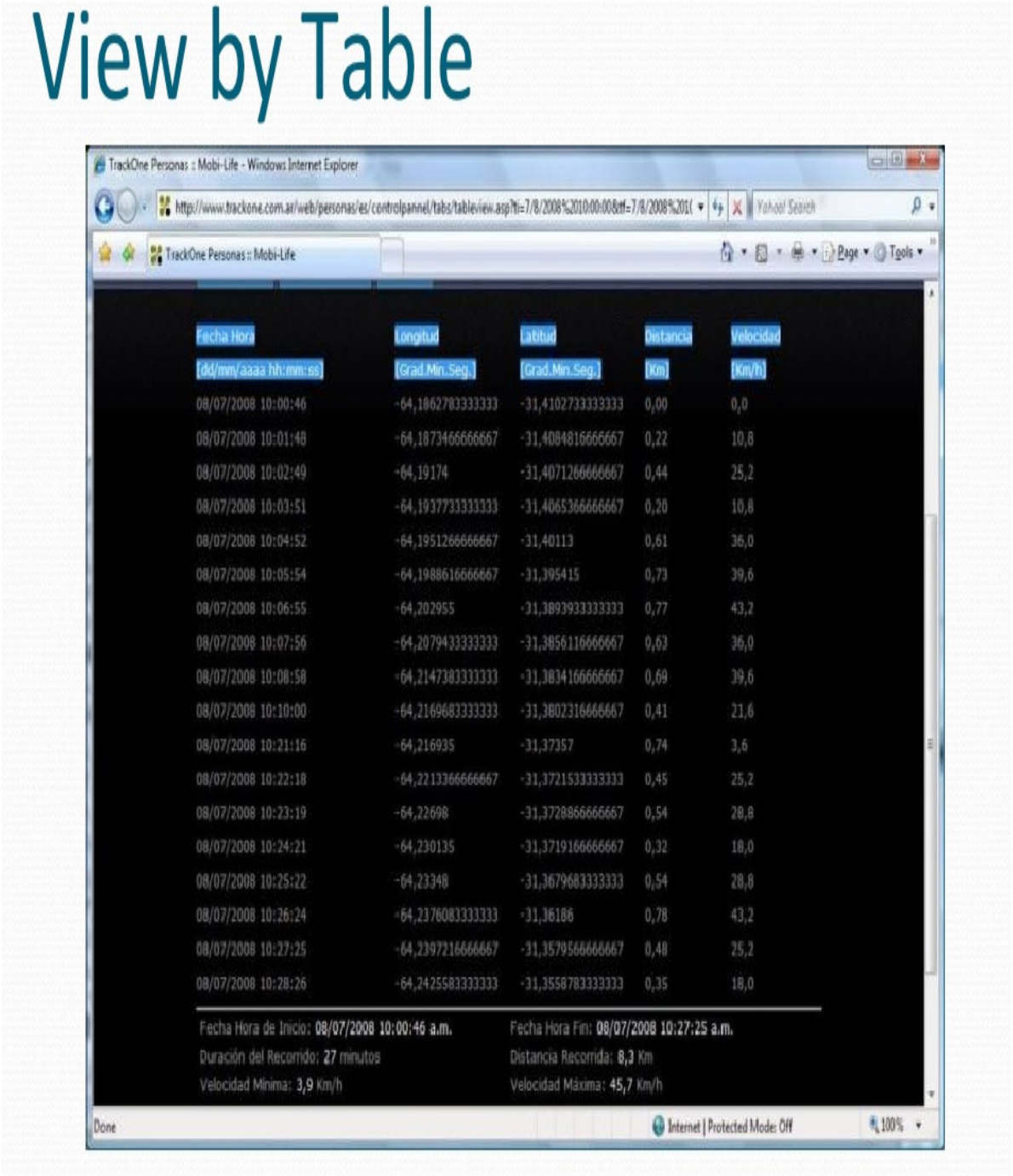

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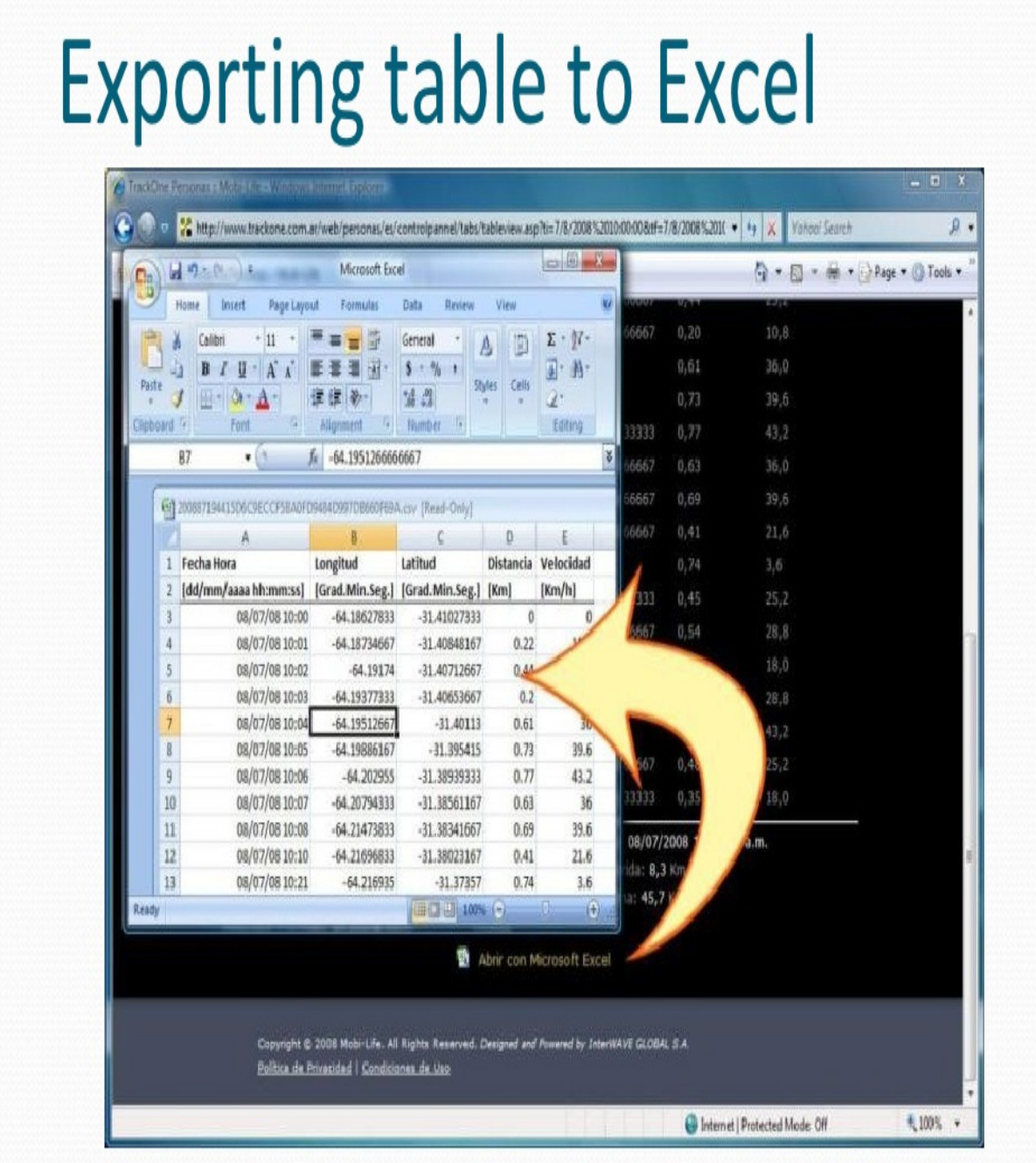

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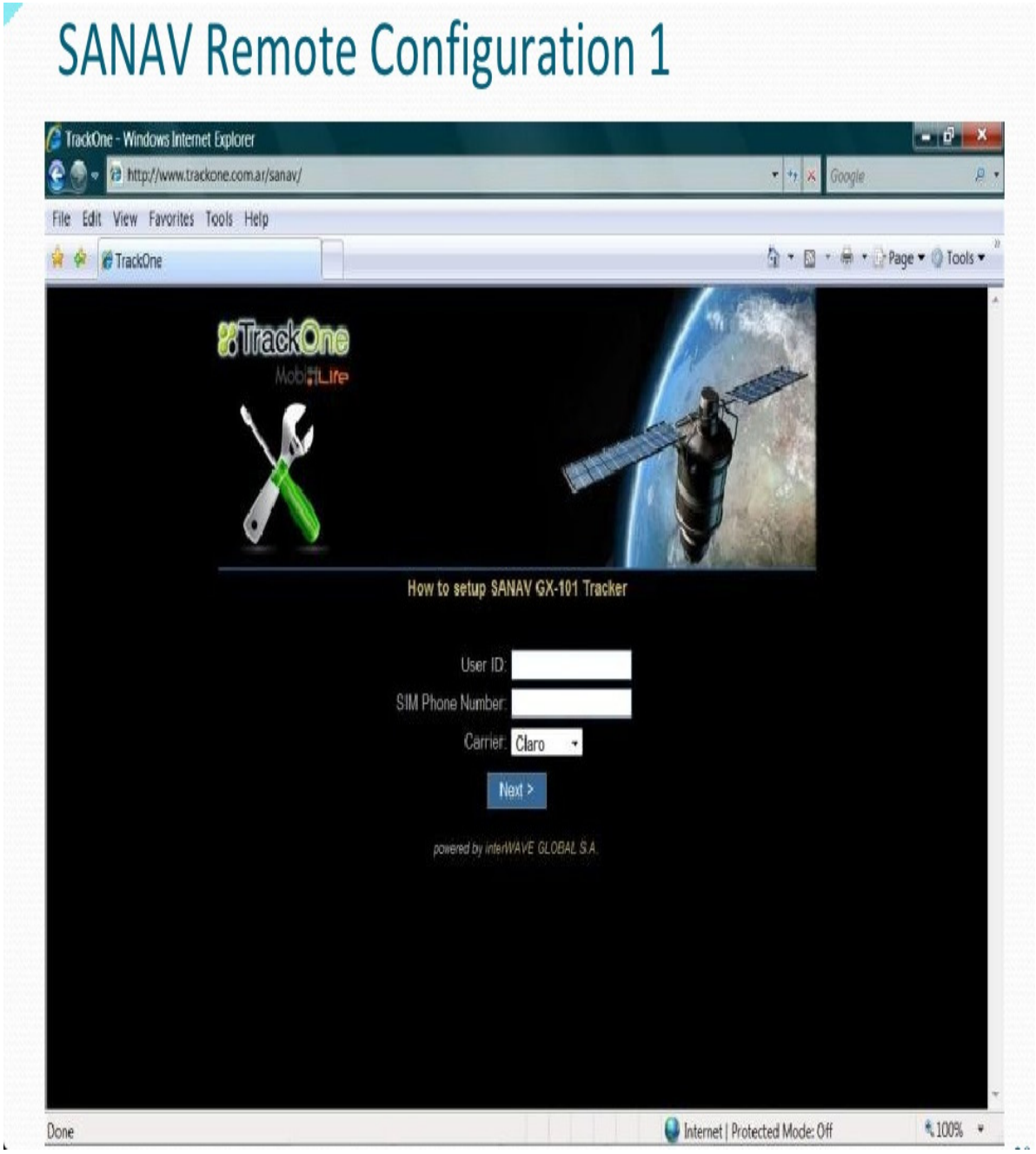

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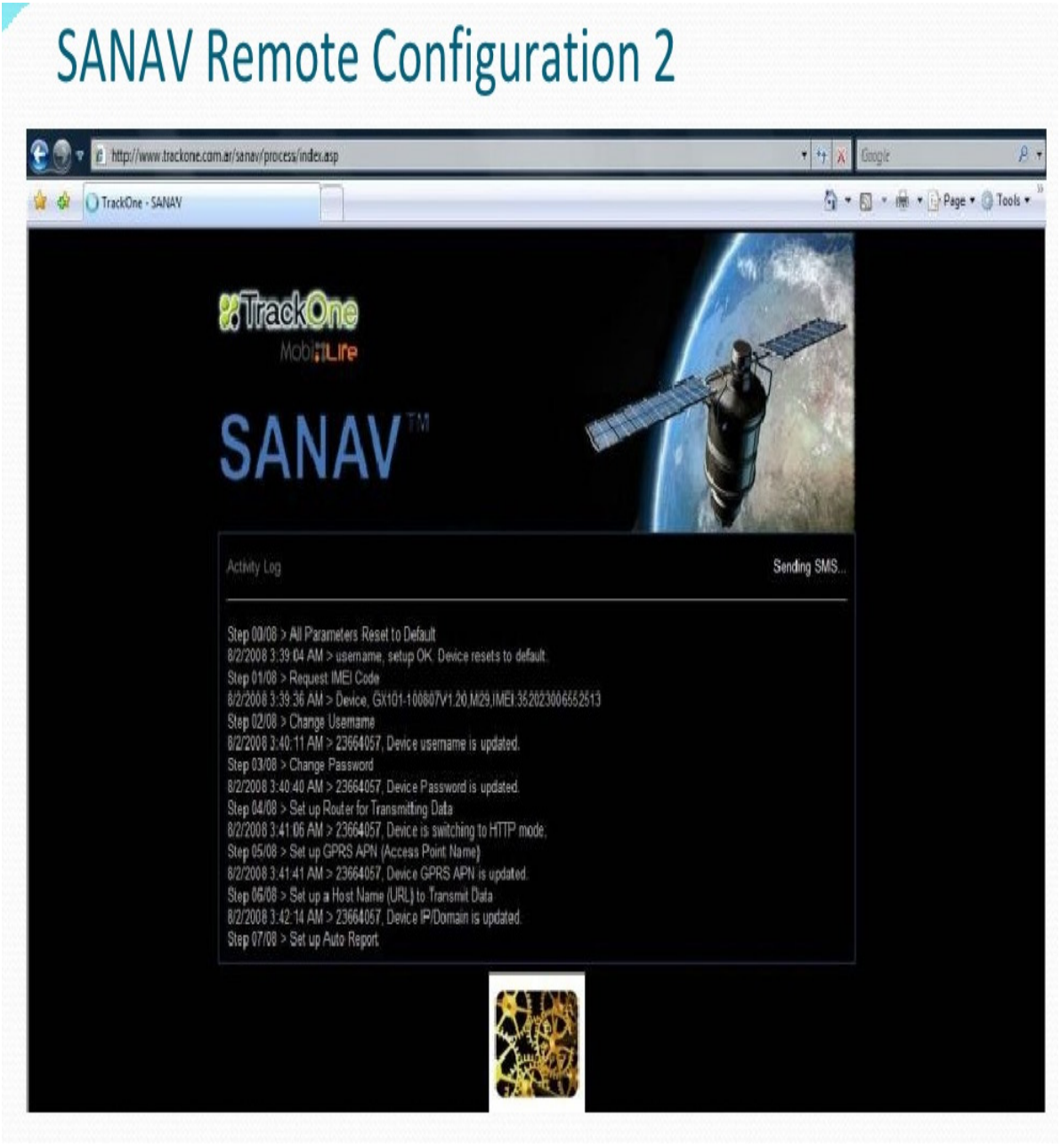

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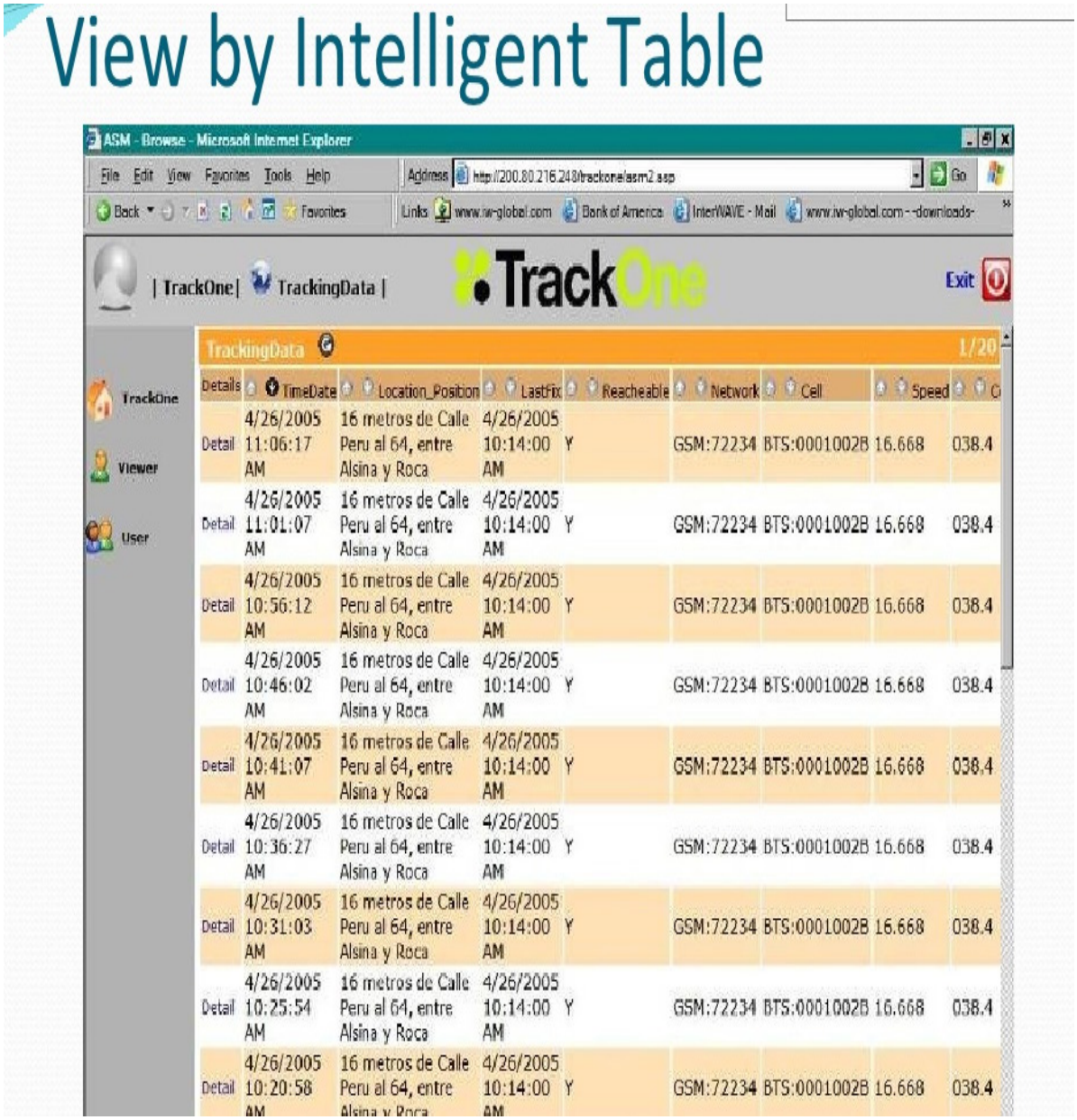

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Analysis of Sea Bed Logging using Scaled Experimental Data with Cubic Spline Interpolation

Hanita Daud, Vijanth S Asirvadam,
Radzuan Radzali & Muizuddin Talib

ABSTRACT

This paper discusses on series of experiments conducted in a scaled down tank that replicates sea bed logging (SBL) environment with various parameter settings which includes the presence and absence of hydrocarbon (HC). Sea Bed logging (SBL) uses Controlled Source Electromagnetic (CSEM) technique in detecting and characterizing HC bearing reservoirs in deep water areas by using resistivity contrasts. In this work a scaled tank with a scale factor of 2000 was built to replicate the SBL environment. Aluminum rod was used as transmitter and a function generator was used to transmit square waves. Magnetic field generated by EM source was detected by fluxgate magnetic field sensor and sent to data acquisition station. Data acquired from series of experiments with variations of hydrocarbon positions, frequency, and amplitude of transmitted electromagnetic (EM) waves with and without HC presence were processed using Cubic Spline Interpolation Technique. Mean Square Error (MSE) was calculated between original and interpolated data. The MSE calculated were used to distinguish data that contained information of HC to the one without HC. It is known that existence of HC shall increase magnitude of received EM wave due to contribution from refracted transmission of EM signals via high resistivity HC reservoir. Comparisons were made using the calculated MSE and it is found that the MSE is higher in the experiments where HC was in the tank. These findings give indication that combination of spline interpolation and MSE can distinguish presence of HC in SBL data.

Keywords: Spline Interpolation, Mean Square Error, Controlled Source Electromagnetic (CSEM), Sea Bed Logging

ABSTRAK

Kertas ini membincangkan mengenai siri ujikaji yang dikendalikan dalam sebuah tangki berskala kecil bagi menyalin semula persekitaran penggalian hidrokarbon dasar laut (Sea Bed Logging) dengan pelbagai perubahan parameter termasuk dengan hadir dan tanpa hadir hidrokarbon. Penggalian hidrokarbon dasar laut (Sea Bed Logging - SBL) menggunakan teknik EM punca terkawal (Controlled Source Electromagnetic) dalam mengesan dan menyatakan tingkah laku hidrokarbon dalam takungan di kawasan air dalam menggunakan kontras kerintangan. Dalam tugasan ini, sebuah tangki berskala, dengan satu faktor skala 2000 dibina bagi mereplika persekitaran SBL. Rod aluminium telah digunakan sebagai pemancar gelombang dan disambungkan kepada satu penjana rangkap yang menyiarkan ombak bersegi. Medan magnet dihasilkan oleh sumber EM telah dikesan oleh penderia medan magnet fluxgate dan menghantar kepada stesen pemerolehan data. Data yang diperolehi dari siri ujikaji dengan variasi kedudukan hydrokarbon, frekuensi, dan amplitud dengan dan tanpa kehadiran HC diproses menggunakan Teknik Interpolasi Splin Kubik. Ralat Min

Kuasa Dua (MSE) dikira antara data asal dan data yang di interpolasi. Pengiraan MSE digunakan bagi membezakan diantara seting yang mengandungi hidrokarbon dan tanpa hidrokarbon. Sebagaimana yang diketahui kewujudan hidrokarbon akan meningkatkan magnitud gelombang EM. Ini adalah disebabkan oleh sumbangan dari biasan penghantaran isyarat-isyarat elektromagnetik melalui takungan hidrokarbon kerintangan tinggi. Perbandingan dibuat menggunakan MSE terhitung dan didapati bahawa MSE bertambah sekiranya hidrokarbon ada di dalam tangki itu. Penemuan-penemuan ini akan memberi petunjuk bahawa gabungan interpolasi splin dan ralat min kuasa dua dapat membezakan kehadiran hidrokarbon dalam data SBL.

Kata Kunci: Interpolasi Splin, Ralat Mean Kuasa Dua, EM punca terkawal, Penggalian hidrokarbon Dasar Laut

INTRODUCTION

One of the important breakthroughs in marine geophysics is the development of new technique for the remote and direct identification of HC reservoirs underneath seafloor based on EM measurement known as Sea Bed Logging (SBL). SBL method is an improvement from Seismic Reflection method for better precision in HC detection and was introduced by [1].. Seismic waves have the ability to detect gas very well but they often fail to discriminate the presence of water or HC in the reservoir [2-4]. Sea Bed logging (SBL) on the other hand uses Controlled Source Electromagnetic (CSEM) technique in detecting and characterizing HC bearing reservoirs in deep water areas by using resistivity contrasts. Due to this SBL is able to distinguish the two liquids (water and HC) based on the large differences in resistivity values as HC reservoirs are known to have resistivity value of 30 – 500 Ωm in contrast to sea water of 0.5 – 2 Ωm and sediments of 1 -2 Ωm [5]. Figure 1 shows the schematic diagram of SBL method [6].

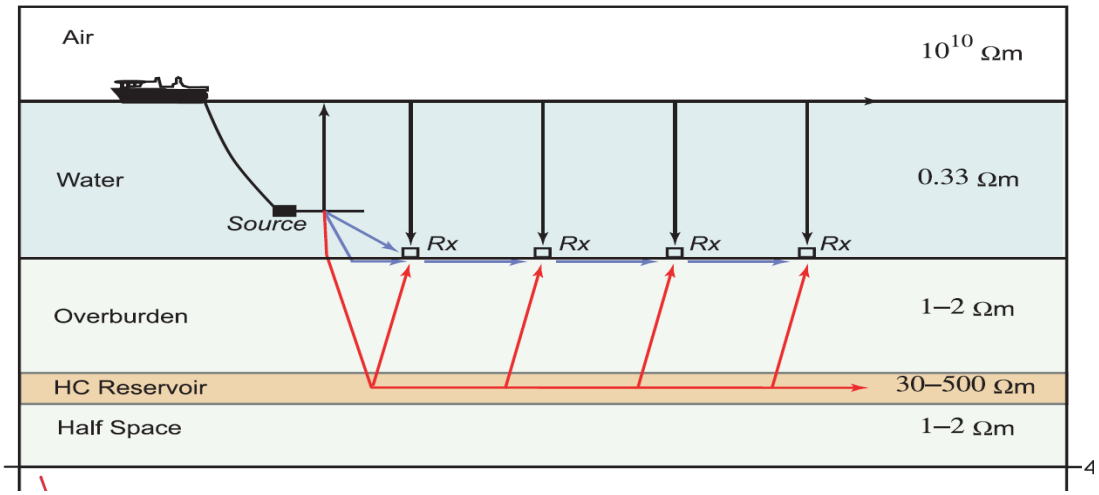


Figure 1: Schematic diagram of SBL method [6]

Summary of the first SBL survey can be found in [7]. This survey was performed owing to successful testing during the early development phase of the method. A scaled experiment was performed in the spring of 1999 in a large water tank at the Statoil Research Center in Trondheim [8] in order to confirm the theoretical predictions that a signal guided in a resistive layer within conductive surroundings could be remotely detected. Along with the experiment

some basic modeling studies had been performed using a forward modeling code developed by [9]. It was found that the data from the experiment agreed well with the modeling results and showed that it is possible to measure the effect of electromagnetic energy being guided within thin resistors contained in conductive media. This whole process involves huge amount of data, therefore processing them using numerical or analytical methods has become a challenge to many geophysicists.

The most common techniques used are Finite element method (FEM), Finite difference method (FDM), Method of moment (MOM), and etc. These techniques involve complicated mathematical procedures thus require good computing facility [10]. Due to this cubic spline interpolation is introduced as a new technique to process these data.

Spline interpolation is a numerical method that is of great significance in various areas of scientific research including scientific visualization, computer graphics, geometric modeling, numerical analysis and etc. It is an effective way of communication as it helps to reflect numeric data to a quickly understandable data or display [11].

This paper presents results obtained from experiments conducted using scaled tank with scaled factor of 2000 that replicates basic SBL environment. The experiments were conducted with variation of HC positions, frequency and amplitude of transmitted electromagnetic (EM) waves. Data acquired from these experiments were processed using spline interpolation technique and MSE were calculated between original data and interpolated data to investigate any significant difference between data that has HC and without hydrocarbon. From these results suitability of spline interpolation and MSE techniques in processing CSEM data is discovered.

THEORETICAL BACKGROUND

Sea Bed Logging

SBL is using an active electromagnetic (EM) sounding technique in detecting subsurface HC. Horizontal electric dipole (HED) source is used as transmitter to transmit low frequency (typically 0.01 – 10Hz). This low frequency electromagnetic wave penetrates from sea water into the underlying subsurface of sea bed. Attenuation of this low frequency EM waves is more in a conductive medium and less in resistive medium due to the skin depth [12-13]. Array of seafloor receivers is used to capture the EM signal that comes back to the seafloor. According to [14], the receivers record the EM responses as a combination of energy pathways including signal transmitted directly through seawater, reflection and refraction via the sea-water interface, refraction and reflection along the sea bed, and reflection and refraction via possible high resistivity subsurface layers. The following section discusses on the theories used in SBL method.

Low Frequency EM Signal

From [2] the propagation (α) and attenuation (β) constants in conductive medium for frequencies below 10^5Hz are defined as

$$\alpha = \beta = \sqrt{\frac{\omega\mu\sigma}{2}}, \tag{1}$$

where ω, μ and σ represent angular frequency, magnetic permeability and conductivity, respectively. Due to non magnetic rocks in sedimentary basins then $\mu = \mu_o$ (magnetic permeability in free-space). Due to this, in the case of fixed geometry, EM energy attenuation depends only on frequency, conductivity and source-receiver distance. Low frequency EM signals decay exponentially with distance z(m) by $e^{-z/\delta}$ where

$$\delta = \left[\frac{2 * \rho}{(8 * 10^{-7} * \pi^2 * f)} \right]^{1/2} \tag{2}$$

ρ, and *f* denote resistivity (Ωm) and signal frequency (Hz) respectively.

Wavelengths, skin depths and phase velocities

From [15] skin depth is a measure of how far the wave will penetrate into the medium. This was based on the assumption that displacement current can be ignored when considering frequencies (in kHz domain) used in the tank experiment. The skin depth, δ, phase velocity, c_p, and wavelength λ for the low-frequency propagation in conductive media are as shown in equations (3) and (4).

$$\delta \approx \sqrt{\frac{2}{\mu_0 \rho \omega}}, \quad c_p \approx \sqrt{\frac{2\omega}{\mu\sigma}} \tag{3}$$

$$\lambda = \frac{2\pi c_p}{\omega} \approx 2\pi\delta \tag{4}$$

where ω is the angular frequency of the EM waves, ρ is the conductivity of the medium where the EM waves propagate and μ_o is the permeability of free space.

The distance required to attenuate an EM signal by factor of e^{-1} (skin depth) is about 551 m in sea water (0.3 Ωm), 1424 m in 2 Ωm sediment, and 10^8m in air (10^{10} Ωm) at frequency of 0.25Hz. EM signals attenuate rapidly in sea water and seafloor sediments saturated with saline water and these signals dominates at near source to receiver offsets (about 3 km). In high resistivity HC filled reservoirs (30 - 500 Ωm) the energy is guided along the layers and attenuated less depending on the critical angle of incidence [16, 17].

Scaled Factor Calculation

The purpose of this scaled experiment is to acquire data with various parameter setups. The ratio of full scale and the laboratory scale dimensions are given by [18]. Full scale dimensions are to be represented by d_{fs} and the lab scale dimensions are to be represented by d_{lab} where the ρ is the conductivity of the medium, μ the permeability of the medium and *f* is the frequency of the transmitter.

$$n = \frac{d_{fs}}{d_{lab}} \tag{5}$$

$$\left(\frac{\rho}{\mu f}\right)_{fs} = n^2 \left(\frac{\rho}{\mu f}\right)_{lab} \tag{6}$$

If the and in (6) are assumed equal for both full scale and experiment set up then

$$\left(\frac{1}{f}\right)_{fs} = n^2\left(\frac{1}{f}\right)_{lab} \tag{7}$$

$$f_{lab} = n^2 f_{fs} \quad \text{or} \quad n^2 = \frac{f_{lab}}{f_{fs}} \tag{8}$$

We may calculate frequency to be used in the scaled experiment by using equation (6). The 1 KHz frequency used in the water tank scale down by a factor of 2000 corresponds to 0.5Hz full scale frequency [18].

Spline Interpolation

Spline interpolation has the ability to correlate data which doesn't follow specific pattern without a single polynomial's extreme behavior and this makes it as one of the best technique to fit any data [19]. Suggested by [21] splines provide a unifying framework for linking the continuous and discrete domains and this makes it a perfect tool for solving a whole variety of signal and image processing problems that are best formulated in the continuous domain but call for a discrete solution. It has been shown by [20] that data generated by a particular function is interpolated by a spline behaves more or less like the original function.

The essential idea of a spline is to provide a cubic equation connecting any two adjacent data points or to fit piecewise function of the form

$$S(x) = \begin{cases} S_1(x) & x \in [x_1, x_2] \\ S_2(x) & x \in [x_2, x_3] \\ \ldots\ldots\ldots & \ldots\ldots\ldots \\ S_{n-1}(x) & x \in [x_{n-1}, x_n] \end{cases} \tag{9}$$

where S_i is a third degree polynomial defined by

$$s_i(x) = a_i(x - x_i)^3 + b_i(x - x_i)^2 + c_i(x - x_i) + d_i \tag{10}$$

for $i = 1,2,\ldots\ldots,n-1.$

The first and second derivatives of these n^{-1} equations are the fundamental to this process and as shown in (11) and (12) below.

$$s_i'(x) = 3a_i(x - x_i)^2 + 2b_i(x - x_i) + c_i \tag{11}$$

$$s_i''(x) = 6a_i(x - x_i) + 2b_i \tag{12}$$

for $i = 1,2,\ldots\ldots,n-1$ [19].

Mean Square Error (MSE)

In statistics, the mean square error or MSE of an estimator is one of many ways to quantify the difference between an estimator and the true value of the quantity being estimated or the difference between the forecasts and observations. MSE measures the average of the square of the "error" [23]. The MSE of an estimator $\hat{\theta}$ with respect to the estimated parameter θ is defined as

$$MSE(\hat{\theta}) = \sum [(\hat{\theta} - \theta)^2]. \quad (13)$$

EXPERIMENTAL SET UP

The scaled model tank was built based on [8] and [16]. The tank has surface area of 1.82 m by 0.91 m by 0.48 m of depth. Saltwater was made by diluting salt in pipe water to increase conductivity of the water to replicate seawater. Aluminum rod of 0.16 m was used as transmitter and was positioned 0.4 m from tank floor. It was connected to a function generator that transmitted square waves at a predefined frequency and amplitude. The transmitter was towed from one side of tank to other side of the tank at a constant speed. The receivers (RC1, RC2 and RC3) were placed in the tank at the height of 0.28 m from bottom and distance between each receiver was kept at 40 cm. Magnetic field generated by EM source was detected by fluxgate magnetic field sensor Mag-03MSS100 and sent to data acquisition station. Block diagram of this set up is as shown in Figure 2. Figure 3 shows the physical components of the set up.

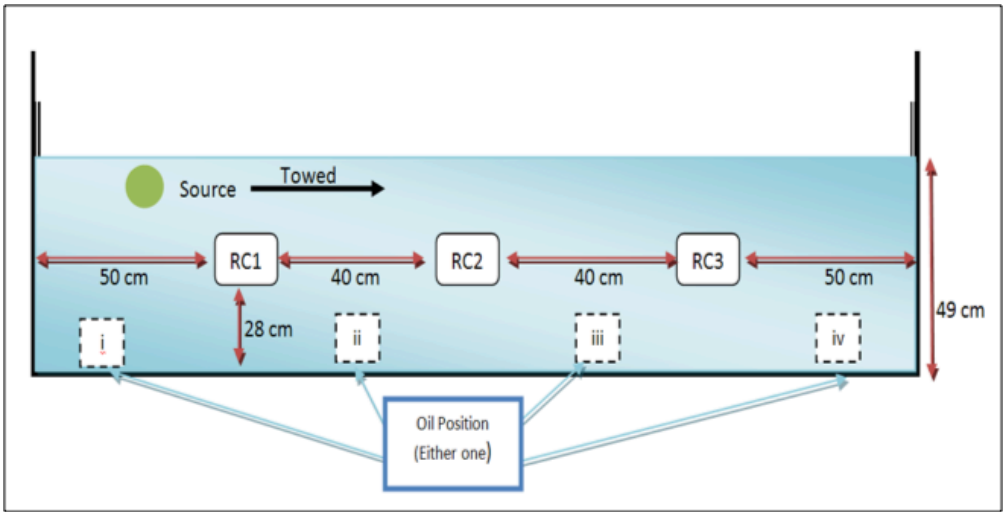


Figure 2: Block Diagram of the Experimental Set Up

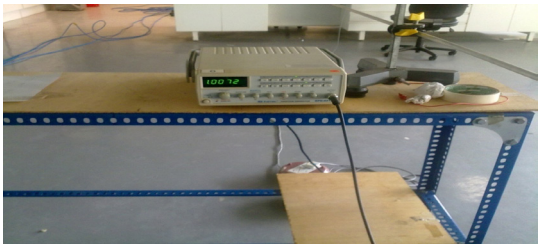
RESULTS AND DISCUSSIONS

Variations of Hydrocarbon Positions

Four HC locations (i, ii, iii and v) were used in this experiment as shown in Figure 2. Data collected from each position were compared to the setup that had no HC. Figure 4 shows magnitude of EM waves at RC1 with and without HC at position (i). Figure 5 shows magnitude of EM waves

(A) Scaled Model Tank Setup

(B) Data Acquisition Station



(C) Source (Function Generator)

(D) Sensor or Receiver

Figure 3: Physical Setup of the Scaled Model Tank Experiment

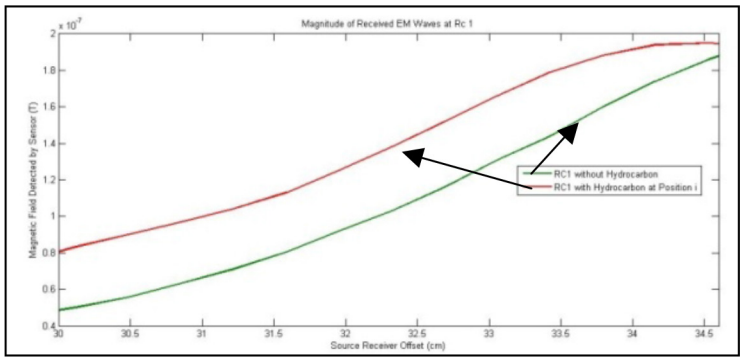
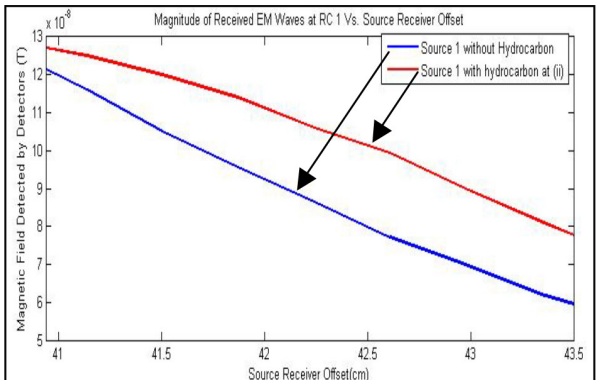
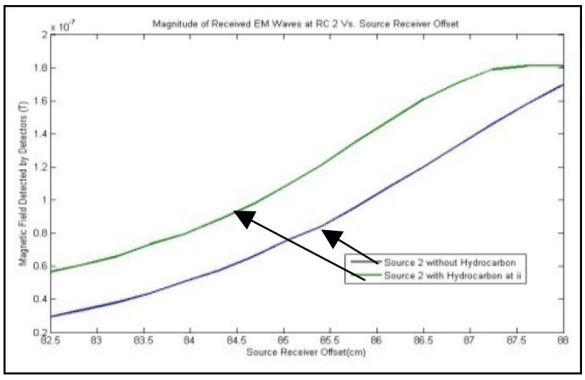


Figure 4: Magnitude of EM Waves at RC1 without and with HC at Position (i)



(A) Magnitude of EM Waves at RC1

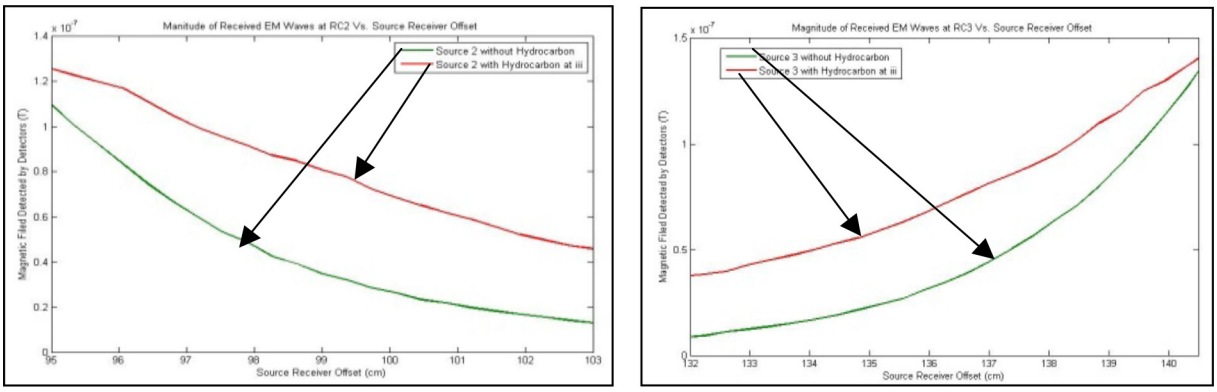


(B) Magnitude of EM Waves at RC2

Figure 5: Magnitude of EM Waves at RC1 and RC2 with and without HC at position (ii)

at RC1 and RC2, Figure 6 shows magnitude of EM waves at RC2 and RC3 with and without HC at position (ii) and (iii) respectively. Figure 7 shows magnitude of EM waves at RC3 with and without HC at position (iv).

Figure 4 shows that presence of HC at position (i) had caused magnitude of E field higher than the one without HC on RC1 and in Figure 7 with HC at position (iv) the E field on RC3 is higher. When HC was in between two receivers, both receivers were having higher E field than the one without HC as in Figure 5 and Figure 6. Higher magnitude of received EM wave was due to contribution from refracted transmission of electromagnetic signals via HC reservoir.



(A) Magnitude of EM Waves at RC2

(B) Magnitude of EM Waves at RC3

Figure 6: Magnitude of EM Waves at RC2 and RC3 with and without HC at position (iii)

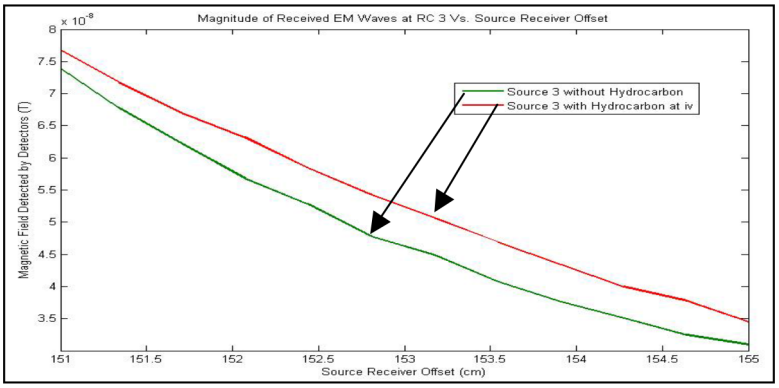


Figure 7: Magnitude of EM Waves at RC3 without and with HC Existence at Position (iv)

Spline Interpolation for Variation of HC Positions

Data acquired from experiments described in section 4.1 had shown significance difference when there were HC at positions (i), (ii), (iii) and (iv) than without HC. These data were interpolated and MSE were calculated between the original data and interpolated data to investigate whether Spline and MSE shall also give significant difference between them and shall become good indicator for the presence of HC.

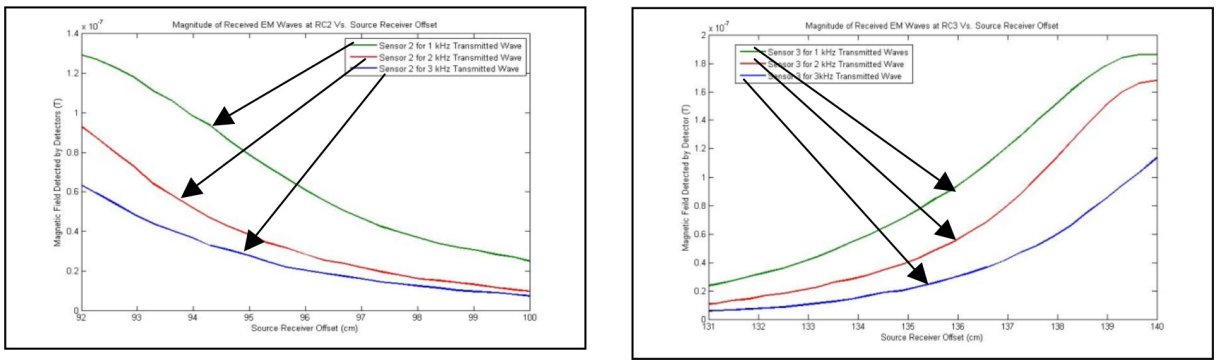
Table 1: MSE between no HC and with HC to the left of RC1, Between RC1 and RC2, Between RC2 and RC3 and to the Right of RC3 after being Interpolated

Setting/ Receiver No	RC1	RC2	RC3
No Oil	2.58 x 10 $^{-18}$	2.55 x 10 $^{-18}$	3.01 x 10 $^{-18}$
Oil on the Left of RC1	**10.93 x 10 $^{-18}$** (Increased by 324%)	**3.66 x 10 $^{-18}$** (Increased by 46.5%)	**5.118 x 10 $^{-18}$** (Increased by 70%)
Oil between RC1 and RC2	**8.51 x 10 $^{-18}$** (Increased by 230%)	**6.48 x 10 $^{-18}$** (Increased by 154%)	**3.14 x 10 $^{-18}$** (Increased by 4%)
Oil between RC2 and RC3	**2.65 x 10 $^{-18}$** (Increased by 27%)	**6.343 x 10 $^{-18}$** (Increased by 149%)	**9.45 x 10 $^{-18}$** (Increased by 214%)
Oil on the Right of RC3	**3.34 x 10 $^{-18}$** (Increased by 29%)	**2.67 x 10 $^{-18}$** (Increased by 5%)	**14.7 x 10 $^{-18}$** (Increased by 388%)

It was found that when HC was at position (i), reading of RC1 had increased by 324% and when HC was at position (ii), readings of RC1 and RC2 had increased by 230% and 154% respectively. The same also for the case when HC was placed in positions (iii) and (iv), the close proximity receivers showed higher readings. The increased in readings were not uniform due to uncontrolled external factors such as position of HC could be nearer to one receiver but farther from the other, non uniform speed and surrounding temperature. From Table 1, we may conclude that receiver with higher MSE gives indications to the presence of HC in its proximity. These findings have given good and impressive indications that data collected in scale tank that have been interpolated and calculated their MSE give significance difference when there was HC in the set up. To further confirm the reliability of Spline and MSE more data shall be collected and processed by varying other parameters such as frequency and amplitude of EM wave. This will be discussed in the next section.

Variations of Transmitted Frequency

Frequency of transmitted EM waves is also a contributing factor to the efficiency of SBL method. Frequencies used in this experiment were 1 kHz, 2 kHz and 3 kHz with HC at position (iii). The focus shall be on the right side of the receiver RC2 and left side of receiver RC3.



(A) Magnitude of EM waves at RC2

(B) Magnitude of EM waves at RC3

Figure 8: Magnitude of EM Waves at RC2 and RC3 using Frequencies of 1 kHz, 2 kHz and 3

It can be seen from Figure 8 that the received EM waves were higher at lower frequency as agreed to the skin depth concept.

Spline Interpolation for Variations of Transmitted Frequency

Data collected from different frequency values in previous section were interpolated and MSE were calculated between the original and interpolated data as shown in Table 2.

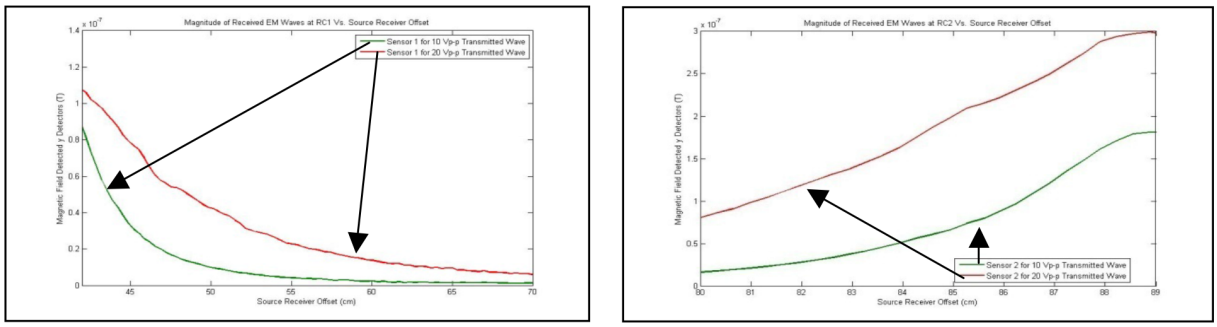
Table 2: MSE of Data Obtained from Frequencies of 1 kHz, 2 kHz and 3kHz Respectively with No HC and HC Between RC2 and RC3

Frequency/ Receiver No	RC1	RC2	RC3
1KHz (No Hc)	2.58 x 10 $^{-18}$	2.55 x 10 $^{-18}$	3.01 x 10 $^{-18}$
1KHz (with HC)	2.61 x 10 $^{-18}$	6.34 x 10 $^{-18}$ (increased by 149%)	9.45 x 10 $^{-18}$ (increased by 214%)
2KHz (No HC)	2.81 x 10 $^{-18}$	2.29 x 10 $^{-18}$	2.96 x 10 $^{-18}$
2KHz (with HC)	3.18 x 10 $^{-18}$	5.52 x 10 $^{-18}$ (increased by 141%)	9.05 x 10 $^{-18}$ (increased by 206%)
3KHz (No HC)	1.21 x 10 $^{-18}$	1.27 x 10 $^{-18}$	1.09 x 10 $^{-18}$
3KHz (with HC)	1.76 x 10 $^{-18}$	2.55 x 10 $^{-18}$ (increased by 101%)	2.90 x 10 $^{-18}$ (increased by 166%)

It is observed that when HC was at position (iii), reading of RC2 has increased by149% and RC3 by 214% respectively for frequency of 1 kHz, and the same increasing trends were observed at different frequency values. It was also observed at higher frequencies the increased in percentage were reduced. These finding agreed with the theory that higher frequency will reduce the amplitude of received EM Waves.

Variations of Transmitted Amplitude

High amplitude of transmitted EM waves shall give clearer EM anomaly of HC existence. The distance required to attenuate EM signal shall be longer. For variation of amplitude of transmitted EM waves, 10 Vp-p and 20 Vp-p were used in the tank. EM waves responses with HC located at position (ii) were observed at receivers RC1 and RC2.



(A) Magnitude of EM waves at RC1

(B) Magnitude of EM waves at RC2

Figure 9: Magnitude of EM Waves at RC1 and RC2 using 10 Vp-p and 20 Vp-p Amplitudes

Higher amplitude was observed when 20Vp-p was used as transmitted amplitude at RC1 and RC2 respectively as shown in Figure 9.

Spline Interpolation for Variations of Transmitted Amplitude

Data collected from different amplitude values were interpolated and MSE were calculated between the original data and interpolated data for set up with and without HC.

Table 3: MSE of Data Obtained from Transmitted Waves of 10V and 20V p-p with No HC and HC between RC1 and RC2

Setting/ Receiver No	RC1	RC2	RC3
10 Vpp (no HC)	2.58×10^{-18}	2.55×10^{-18}	3.01×10^{-18}
10 Vpp (with HC)	8.51×10^{-18} (increased by 230%)	6.48×10^{-18} (increased by 154%)	3.14×10^{-18}
20 Vpp(no HC)	1.39×10^{-18}	1.15×10^{-18}	1.19×10^{-18}
20 Vpp (with HC)	7.62×10^{-18} (increased by 448%)	3.70×10^{-18} (increased by 222%)	1.46×10^{-18}

It is also observed here that there were significant differences in MSE percentages for the set up with and without HC. The results also agreed to the theory that the higher the transmitted EM waves generate higher value in the received EM signal.

CONCLUSION

From the findings on the MSE values from Table 1, Table 2 and Table 3, we may conclude that data or receiver with higher MSE gives indications to the presence of HC in its proximity. Results have shown that when HC was placed at various positions to investigate effect of EM waves, it was found that the receivers closer to the HC gave higher amplitude of EM waves. Results also have shown that as the frequencies increase, the skin depth decreases, these affect the magnitude of received EM waves. Higher transmitted signal also resulted in higher received EM waves.
This concludes that data that have been interpolated using Spline interpolation and calculated mean square error were giving very high percentage differences for settings with HC. Our findings also suggested that combinations of these two techniques have good potential to be used as new processing tools for CSEM data.

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Hanita Daud*
Radzuan Radzali
Fundamental and Applied Sciences Department
Universiti Teknologi PETRONAS, Bandar Seri Iskandar,
Tronoh, Perak, MALAYSIA

Vijanth S Asirvadam
Muizuddin Talib
Electrical and Electronics Engineering Department2,4
Universiti Teknologi PETRONAS, Bandar Seri Iskandar,
Tronoh, Perak, MALAYSIA

**Corresponding Author: hanita_daud@petronas.com.my, 05-3687844*

22

Optimization of Silicon Nitride Y-branch Optical Waveguide for Evanescent Field Biosensor

Khor Kang Nan, M. M. Shahimin, F. R. M. Adikan & S. Z. Naziri

ABSTRACT

Evanescent field had been widely used in bio and chemical sensors. However in most cases, evanescent field is not maximized and thus the performance of the sensor is not optimized. It is the aim of the paper to optimize the design of 1:2 Y-branch splitter optical waveguide through simulation by using FD-BPM. Y-branch splitter without taper are simulated to optimize the power loss. Width of waveguide and effective angle are manipulated in the power loss optimization. The result shows that evanescent field is maximized at optimized thickness and width. The result suggests that Y-branch splitter with width of 25μm, effective angle of 6.24° is the best design for evanescent field sensor application with both high sensitivity and signal to noise ratio. These studies will continue towards the development of a novel silicon nitride waveguide as an evanescent field biosensor, with biological material studies presently underway.

Keywords: Integrated optic, Y-branch splitter, beam propagation method, evanescent field optimization.

INTRODUCTION

Waveguide based bio and chemical sensors, utilizing evanescent field have attracted a lot of attention this past decade due to its versatility and advantages. One of the major advantages among other optical sensors is simple, robust and label-free measurement whereby output power of the waveguide can be directly monitored [1]. Evanescent field is the waveguide mode that penetrates through core layer of waveguide and extending typically 30-250nm into the cladding and substrate region depending upon the refractive index matrix of the system, as shown in **Fig. 1** a). It is sensitive to bulk refractive index of cover layer or growth layer formed by binding of analyte [2]. Non-homogeneity and the surface roughness of the thin adlayer can cause light scattering and thus output power is significantly reduced upon the detection of analyte binding on the waveguide surface [3]. Y-branch splitter had been used as evanescent field sensor with one of the output branch served as sensing site and the other as reference [4]. Hence, the difference between output power can be detected directly and instantly which is advantageous compared to linear waveguide that is used in [3]. The model of Y-branch splitter used as evanescent field biosensor is shown in **Fig. 1** b). Reservoir is used to hold liquid/gaseous sample for binding of analyte and sensing.

Sensitivity and signal to noise ratio are two important parameters for any sensor. Sensitivity of the sensor is the amount change of the measuring parameter regarding to same analyte

concentration. On the other hand, signal to noise ratio is the immunity of the measuring signal to noise. Sensitivity of evanescent field sensor is highly affected by strength of evanescent field with respect to its penetration depth and intensity. As more power penetrates through waveguide-cladding interface, more power is scattered by analyte binding and thus bigger output power contrast is obtained upon biological cell detection. Concept of optimizing evanescent field of linear waveguide had been proposed by [5] and [6, 7] had shown the simulation and experimental results of optimizing linear ion-exchanged channel waveguide with respect to biological cells propulsion.

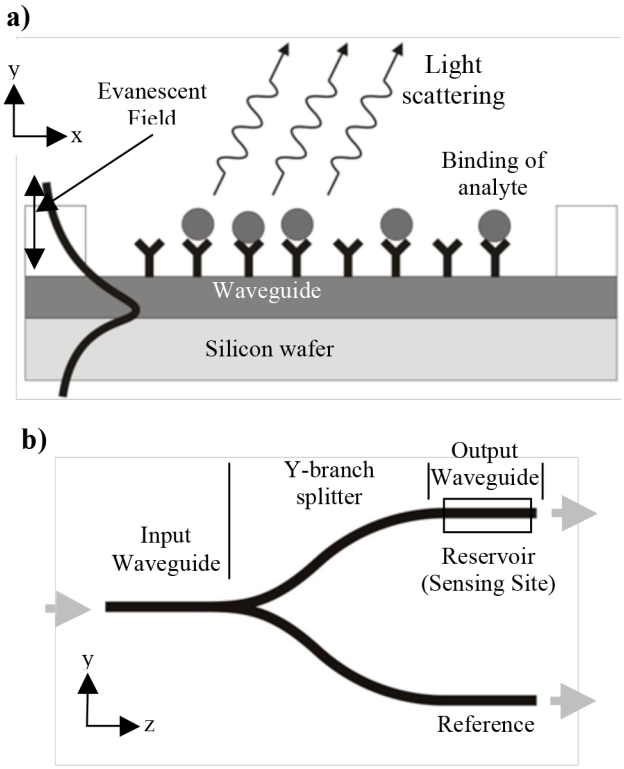


Figure 1: (a) Scattering of evanescent excitation binding of analyte on the waveguide surface. (b) Y-branch splitter used as evanescent field biosensor

In this paper, the main concern is more on signal to noise ratio as it is a more serious issues in practical world of biosensor [8]. It is important to prevent the disturbance of noise (electromagnetic wave from sunlight) from the surrounding to the output signal. The only way to improve signal to noise ratio is to increase the power of output signal with respect to the noise. Hence, power in the output waveguide must be increased. Besides, higher power of waveguide mode can also increased the strength of evanescent field and improved the sensitivity accordingly. Power optimization can be done through high refractive index material selection and reducing power loss of Y-branch splitter. Bio-compatible material with high refractive index had been widely used to fabricate biosensor such as silicon carbide [4, 9] (n=2.5), silicon nitride [10] (n=2), tantalum pentoxide [11] (n=2.092) and lastly titanium oxide [12] (n=2.4). These materials can preserve high power in waveguide due to high refractive index contrast with silicon oxide.

Simulation is carried out in the design of Y-branch splitter with the aim of reducing power loss. Power loss is consists of coupling loss, bending loss, mode conversion loss and propagation loss. Coupling loss is the loss suffered at the interface between optical source and input waveguide

which is caused by reflection of light by the refractive index contrast between air and waveguide. Bending loss is the loss caused by any bending waveguide or tapering due mainly to the non-linearity of the waveguide. Mode conversion loss is the loss suffered at the end of the Y-branch splitter tapering whereby mode from input waveguide is converted into supermode (dual-peak) in bending waveguide. Finite difference beam propagation method (FD-BPM) is used in this paper in the simulation of optical field propagation throughout the designed waveguide such as bending and linear channel portion of the waveguide. FD-BPM is more powerful compared to FFT-BPM (Fast Fourier Transform Beam propagation method) in the simulation of 3D optical waveguide with high non-linearity such as bending and tapering [13].

METHODOLOGY

Y-branch splitter is simulated and designed with the aim of minimizing power loss as shown in **Fig. 2**. TE polarization with wavelength of 1.064μm is used in Y-branch simulation for the ease of analysis. Thickness and width used in the simulation are 0.1μm and 4μm respectively based on linear channel waveguide simulation results. Refractive index of cladding, waveguide and substrate layer is 1.33, 1.98 and 1.45 which correspond to water, silicon nitride and silicon oxide respectively.

Y-branch splitter without taper can be easily constructed in the simulation software by using bending waveguide. This type of Y-branch splitter is characterized by bigger width of input waveguide and taper elimination. Y-branch splitter without taper is investigated due to some reasons. First, width of input waveguide is increased to allow more power transmission from laser source to input waveguide. Besides, taper that induced losses is eliminated. X_{off}, L_{off} and θ_{eff} are the parameters that characterize Y-branch splitter. X_{off} is the distance between two output branches, L_{off} is the horizontal distance of bending waveguide and θ_{eff} is effective angle of Y-branch splitter which is related to X_{off} and L_{off} as shown in (1).

$$\theta_{eff} = 2 \times \tan^{-1} \frac{\left(X_{off}/2\right)}{L_{off}} \tag{1}$$

X_{off} is made constant at 120μm in this paper to avoid power interference between branches and for the ease of handling of sample or chemical on the output linear waveguide. Thus, the only parameter that affects power loss is L_{off}. Bending waveguide used in the construction of Y-branch splitter is cosine bending waveguide as the reported power transmission is only slightly lower than simplified coherent coupling bending waveguide [14].

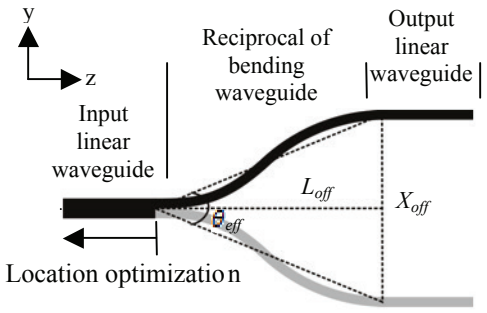


Figure 2: Model of Y-branch splitter without taper

Waveguide with thickness of 0.1μm and width of 4μm is multimodal which is proved by the mode beating in input waveguide and it had been found in [15] that mode intensity profile at the end of input waveguide affects mode conversion loss. In order to investigate this relationship between mode intensity profile at input waveguide end and mode conversion loss, location of bending waveguide is shifted toward input waveguide to change the mode intensity profile at taper end. Simulation of Y-branch splitter with variation of start location of bending waveguide for mode conversion loss enhancement is known as location optimization. Start location is varied from 205μm to 155μm with step of 5μm in simulation of location optimization. The range of L_{off} used in investigation of Y-branch splitter are from 300-2100μm with step of 200μm and result in θ_{eff} that is in the range of approximately 3°-22°. As the L_{off} increases, θ_{eff} and slope of bending waveguide reduces while length of bending waveguide increases. Simulation is repeated to perform location optimization to maximize *Pout* at each effective angle.

The simulation is followed by the increment of the width of Y-branch splitter from 4μm to 10μm with location optimization. This is because more power can be confined in waveguide and thus it theoretically it can reduce the bending loss of bending waveguide. Width of waveguide is further increased to 15μm, 20μm and 25μm without location optimization so that relation of width to output power can be further investigated.

RESULT AND DISCUSSION

Fig. 3 a) shows the result of *Pout* as a function of effective angle for Y-branch splitter without taper with input width of 8μm. Since width of input waveguide of Y-branch splitter without taper is double of width of bending and output waveguide as shown in **Fig. 2**, width of the bending and the output waveguide is only 4μm. It can be seen that location optimization increase *Pout* significantly. Besides, *Pout* profile of Y-branch splitter without taper is consist of rapid increment of *Pout* to a peak followed by gradual decrement of *Pout* with reduced effective angle. *Pout* profile is mainly affected by bending loss which is in turn affected by the effective angle. Rapid increment of *Pout* is caused by the optimized effective angle which resulted in optimized branching angle and length of bending waveguide. On the other hand, gradual decrement is caused by longer length of the bending waveguide with slight decrement of rate of the bending loss.

Fig. 4 shows the result of *Pout* as function of the effective angle for input width of 20μm with and without location optimization. It can be seen that increment of *Pout* caused by location optimization is insignificant for width of 10μm (or input width of 20μm). This is due mainly to the increasing number of mode as width increases and thus the mode beating profile changes in input waveguide as shown in **Fig. 3** b). Due to this reason, location optimization is not performed in Y-branch splitter with bigger input width than 20μm.

Fig. 4 b) shows the *Pout* as function of effective angle for input width of 8μm, 20μm, 40μm and 50μm. It can be seen that the increment of *Pout* for input of 20μm from 8μm is significant whereby *Pout* is increased by 19.7%. The increment is mainly due to the better power confinement in the bending waveguide and thus the bending loss is reduced regardless of effective angle. However, increment of *Pout* become smaller as input width is further increased to 30μm, 40μm and 50μm. *Pout* increment is caused by reducing bending loss and increased power transmission at coupling of laser source. On the other hand, *Pout* increment is limited by maximum power transmitted from input waveguide into bending waveguide since power in input waveguide is

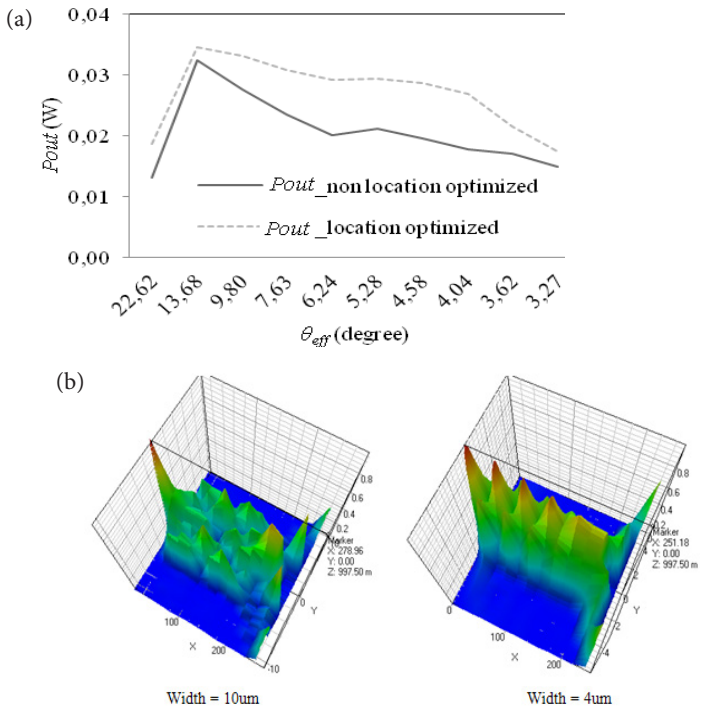
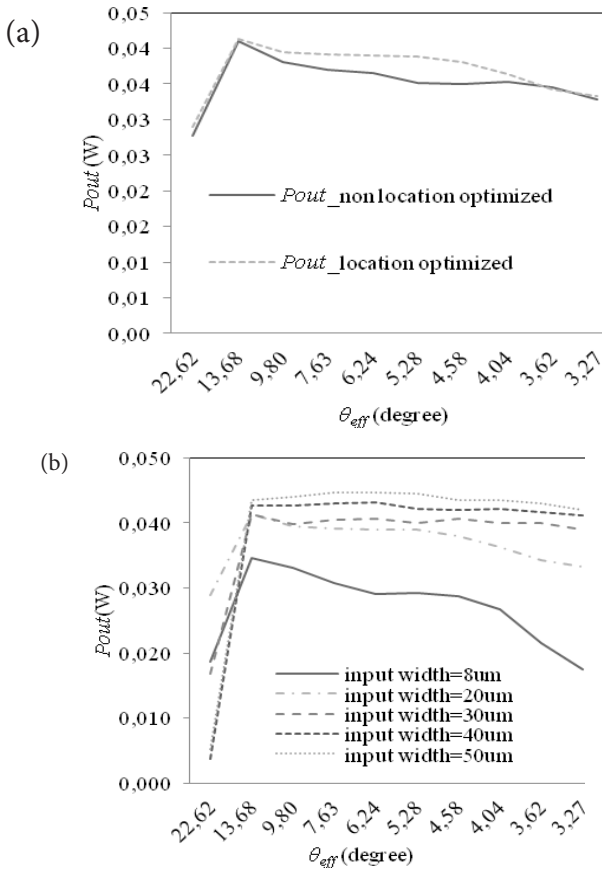


Figure 3: (a)*Pout* as function of effective angle with and without location optimization for input width of 8μm. (b) Mode beating profile of input waveguide for width of 10μm and c) 4μm respectively



Figuew 4: (a) Pout as function of effective angle with and without location optimization for input width of 20μm. (b) Pout as function of effective angle for input width of 8μm, 20μm, 30μm, 40μm and 50μm. Location optimization is performed only on Y-branch with input width of 8μm and 20μm

increased by 1.33% only with width of waveguide doubled. As a result, *Pout* is almost saturated by optimization of bending loss after the input width is increased to 20μm and further increment of width increases *Pout* by slight increment of power in input waveguide. At input width of 50μm, the maximum *Pout* is 0.045W.

CONCLUSION

The paper is aimed to design Y-branch splitter with optimized evanescent field and minimum power loss so that sensitivity and signal to noise ratio of biosensor can be improved. Simulation of Y-branch splitter shows that location optimization is crucial in maximizing evanescent field at smaller width (4μm). Besides, *Pout* is only maximized starting at certain effective angle which is 13.68° and Y-branch splitter with bigger effective angle suffers severe bending loss. However, it had been found that *Pout* is reduced with further reduction of effective angle at smaller width. The *Pout* decrement at smaller effective angle is mainly due to the longer length of bending waveguide that suffers bending loss. Bigger widths of bending waveguide shows that better power confinement reduce the bending loss. The results show that Y-branch splitter without taper required waveguide width of 25μm in order to reach the optimum power of 0.045W. There is a need to reduce width of output waveguide to 4μm using taper in order to maximize evanescent field which is the major disadvantage of using Y-branch splitter without taper. Results in this paper suggest that Y-branch splitter of 25μm width, effective angle of 6.24° and thickness of 0.1μm to be the optimum design for evanescent field sensor application with both high sensitivity and signal to noise ratio.

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Khor Kang Nan
M. M. Shahimin*
S. Z. Naziri
School of Microelectronic Engineering,
Universiti Malaysia Perlis, 02600 Arau, Perlis, Malaysia.
**mukhzeer@unimap.edu.my, 010-2269448*

F. R. M. Adikan
Department of Electric Engineering,
Faculty of Engineering, University of Malaya,
50603 Kuala Lumpur, Malaysia.

23

Load Shedding Scheme in Large Pulp Mill by Using Analytic Hierarchy Process and Fuzzy Analytic Hierarchy Process

H.H. Goh, S.W.Lee, B.C. Kok, K.C.Goh, T.W.Seow & K.T.K.Teo

ABSTRACT

The advancement of technology had encouraged mankind to design and create useful equipments and devices. These equipments enable users to fully utilize them in various applications. Pulp mill is one of the heavy industries that consumes large amount of electricity in its production. Due to this, any malfunction of the equipment might cause mass losses to the company. In particular, the breakdown of the generator would cause other generators to be overloaded. Thus, load shedding scheme is the best way in handling such condition. Selected load will be shed under this scheme in order to protect the generators from being damaged. In the meantime, the subsequence loads will be shed until the generators are sufficient to provide the power to other loads. Once the fault had been fixed, the load shedding scheme can be deactivated. In order to determine the sequences of load shedding scheme, analytic hierarchy process (AHP) is introduced. Analytic Hierarchy Process is one of the multi-criteria decision making methods. It had been used in solving a lot of decision making problems since ages ago. AHP is widely used in comparing the options in order to achieve the goal. For the application of AHP in load shedding, the operating load and the area power are chosen to be the criteria. The options of each criterion will be the load of the electrical system in the pulp mill. On the other hand, fuzzy AHP is the advanced version of AHP which can solve the uncertainty of the pair-wise comparison and gives more accurate results in fuzzy situation. This paper presents the alternative methods to choose the load priority in load shedding scheme for a large pulp mill. The results of the AHP and fuzzy AHP analysis to the pulp mill are very promising.

Keywords: Analytic Hierarchy Process (AHP), fuzzy AHP, load shedding, pulp mill.

INTRODUCTION

China is one of the mass production countries around the world. The import activities and consumption of paper is in a huge amount. China's pulp mill industries grow by importing the pulp wood to 300% of the previous amount from 1997 to 2003. It covers 13% of the global market. According to the paper production and consumption statistic, pulp production in China amounted approximately 20 million metric tons in 2008. There are also 84 million tons of paper and board production in total. Besides, China also imported 10 million tons of pulp and 24 million tons of recycled fibre [1]. Many of the investors around the world had taken the opportunity to establish their industries in China. Asia Pulp & Paper (APP) which is maintained by Sinar Mas Group from Indonesia is one of the largest organizations among the competitors. The APP's production facilities implement newer and more efficient paper making technology and therefore the carbons

emissions are averagely lower than most of the paper makers. Besides, APP also supports more than 500,000 hectares of tropical forest as conservation area which acts as a massive carbon storage [2]. Due to APP as one of the mass production of paper and pulp, they have the responsibility to ensure the sustainability either in conservation of social or environment.

In pulp mill, there are quite a number of areas of land being used to allocate the equipment and devices [2]. The electrical system must be well managed in order to ensure that the operation in the mill is fully utilized. However, there might be breakdown in the electrical system due to the longer working period of the machines. The malfunction of the equipment or devices might cause huge losses to the company. Due to this, the load shedding scheme is needed in the pulp mill to prevent damage of the power generator.

In order to provide the manageable and controlled over the whole system in the pulp, an advance and relevant mill wide automation system and mill wide electrical load shedding system are placed in the centre of a control room which are operated by the well trained engineers or technicians. There are a lot of supervisory control and data acquisition (SCADA) system providers and SIEMENS is one of them [3]. SIEMENS provides the software which can communicate with SIEMENS PLCs using various communication devices in different protocol. Commonly, the protocol of the devices is object linking and embedding process control (OPC), Profibus and Modbus. By using SCADA, engineers or technicians can monitor the electrical system in the control room and take the fastest response towards any problems occurred. With the SCADA system, the remote switching of equipment or devices can also be done. This is effective in order to reduce the down time of the system.

Load shedding is defined as the action of switching off the electrical supply to parts of the electricity system [4]. H.H. Goh and B.C. Kok proposed the idea of AHP in load shedding scheme for the electrical power system [5]. As in the paper, the judgments of the importance of the criteria are based on the experiences gained. For instance, the frequency is 5 times more important than voltage whereas the important of frequency is also twice of the stability. In the study, they had also justified 5 criteria and 5 alternatives as the elements in determining which is the most prior to the load shedding scheme.

Load shedding might cause the loss of some information but it is possible to keep other equipments or devices which are more important to operate. The system will operate as normal once the system had been restored. Although the practice is rare, it is a core part of the emergency management of all the electricity networks. There are several ways in handling load shedding problems. For example, proportional or priority load shedding are commonly used to alleviate network violations [6]. The loads will be cut off if the power flow and voltage could not be alleviated. Another technique which is optimal power flow (OPL) method which is proposed by Dornellas *et al*. [7] in order to solve the over curtailed problems. Besides, Wang and Billinton [8] also proposed optimum load shedding techniques to minimize the interruption cost in the power system. No matter how, the main purpose of the load shedding is to prevent the damage of the whole system.

One of the most important elements in an industry is the electricity supplies. Each component that needs the electricity will consume the power provided by the generator. The blackout will cause losses to the industry. All operations that need electricity are forced to be halted. Due to this, most of the industries usually accommodate electric power generator for emergency use. Although the

generator might not provide the electric power sufficiently, the main operation of the industry still can be maintained. However, there must be some loads that need to be shut down or turned off in order to maintain the power provided by generator during black out. Due to this, the load shedding scheme had been introduced. The main objective of load shedding scheme is to solve the system voltage, load overloading, frequency and power balance problems. For examples, G.L. Cai *et al.* [9] use optimal multiplier power flow to do the corrective load shedding algorithm. The main purpose of the corrective action is to prevent the voltage collapse. Voltage collapse could be happen if the system does not satisfy the active power and reactive power demands. Besides, under voltage load shedding can also use the prior load selection in the load shedding scheme [10-12]. C.W. Taylor stated that there can be two extremes to be considered in analysis; a high proportion of motor load and a high proportion of resistive load [10]. The under voltage relays are fixed around the potential area and activate when necessary.

On the other hand, black out will also occur when the load increasing in a short time. At meanwhile, the generator will sense the speed change and it will increase the input power. Due to the disturbance, it might cause the frequency drop. Thus, under frequency load shedding should be activated at this time. V. Chuvychin *et al.* [13] proposed adaptive under frequency load shedding and under frequency load restoration system to make the automated load shedding system to be response faster. M.Karimi *et al.* used under frequency load shedding method on islanded distribution metwork in Malaysia [14]

For the application of load shedding for shipboard power systems, Z.P. Ding, S. Srivastava, and D. Cartes used AHP loads priority selection [15]. They used AHP to calculate the weight factor of each system criterion and it is effective. Generally, the load shedding of shipboard power system (SPS) is performed in several stages. The load shedding stage will trigger one by one until the load had been curtailed to the preset safe level. The triggering time for the power relay is preset by the technicians or engineers. If the stage 1 of the load shedding scheme did not reduce the electric plant load sufficiently, the stage 2 will shunt the breakers automatically [15]. Besides, there are researchers using neural network and differential evolution to execute optimum load shedding scheme for voltage stability [16-18].

For this paper, the priority of the criteria is initially unknown. The ratio among the criteria will be determined. From the result, the prior of the criteria will be obtained. The objectives of this paper are to study alternative ways to remove overloads situation of load shedding scheme in a large pulp mill by using Analytical Hierarchy Process (AHP) and Fuzzy Analytical Hierarchy Process (Fuzzy-AHP). In addition, the efficiency of both multi decision making methods is compared.

BACKGROUND OF STUDY

The application of analytic hierarchy process

The AHP approach is a powerful and flexible decision making process, and it was developed by Dr. Thomas Saaty, professor at the University of Pittsburgh [19]. It can be used either for the analysis or comparison among criteria. Christos Douligeris [20] had used AHP in analyzing and comparing the quality of several telecommunications companies. He also made the evaluation of alternate technologies in telecommunication [20].

On the other hand, Les Frair *et al*. had used Analytic Hierarchy Process in undergraduate curriculum evaluation. During the evaluation, the affected parties (students, faculty, employers, etc.) evaluate the curriculum alternatives through internet web site [21].

Besides, the AHP approach is also used in solving management problem. For example, Krystak Ramoutar and Chanan S. Syan analyzed the critical factors associated with successful implementation of WCM techniques in ISO 9001 certified firms based on AHP. They found that resistance to change is the most critical factor that leads to successful of ISO9001 implementation [22].

S. Yue, J. Yu, and B. Liang used the combination of data envelopment analysis (DEA) and AHP in their research on based assessment method of power system black-start effective schemes of ancillary services. By using the AHP approach, the best sequence of restoration path had obtained [23].

In the production of a company, the selection of machine tool must be done wisely. There are a lot of criteria need to be considered such as cost, profit, and period of modal returning. In order to make the best decision with given conditions, E. Cimren *et al.* used the AHP approach in machine tool selection. The priority of the alternatives can be changed from time to time. For example, one of the alternatives in machine tool named MX-50HB was ranked in the first place if cost analysis is the most prior for all the criteria. However, once the most prior criteria changed to reliability, machine tool named V-40 became the first among alternatives [24]. Thus, it is possible to make the final decision if the priority among cost and reliability could be identified clearly.

The application of fuzzy analytic hierarchy process

The Fuzzy Analytic Hierarchy Process (Fuzzy AHP) is the extension of AHP method that can solve the uncertainty of the fuzzy data. Due to the fuzzy situation, the data might be insufficient to make a comparison. The triangular fuzzy numbers are used for the preferences of one criterion over another in the fuzzy AHP approach. Then, the synthetic extent value of the pair wise comparison is calculated [25]. Fuzzy AHP is widely in used practically. For example, S. Mahmoodzadeh *et al.* [26] had proposed a new method which is a combination of fuzzy AHP and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to deal with project selection problems. On one hand, B. Serkan and K. Serdar also used the combination of fuzzy AHP and TOPSIS method to select the operating system [27]. On the other hand, H.H. Goh *et al.* used the combination of AHP and TOPSIS to analyse the load shedding for a pulp mill [28].

Meanwhile, M. Monitto *et al*. [29] used fuzzy AHP to make the decision in selection of the best Automated Manufacturing System. According to M. Monitto, the fuzzy AHP is able to manage the uncertainty and to consider productivity and flexibility issues. In particular, uncertainty due to unpredictable conditions has been analyzed by relationships among the fuzzy parameters related to the uncertain events. Furthermore, T.S. Li and H.H. Huang also used fuzzy AHP to develop innovative design for automated system [30]. They used the Russian Theory of Inventive Problem Solving (TRIZ) to propose the new automated design alternatives under innovative design consideration and then used the fuzzy AHP to support the evaluation of alternatives under vagueness and uncertainty situations.

In comprehensive survey, the AHP and fuzzy AHP have not been introduced in load shedding priority selection. Thus, the new method in determining the priority will be discussed in this

paper. Each of the method has its significant difference. The comparison between two methods will also be discussed in this paper.

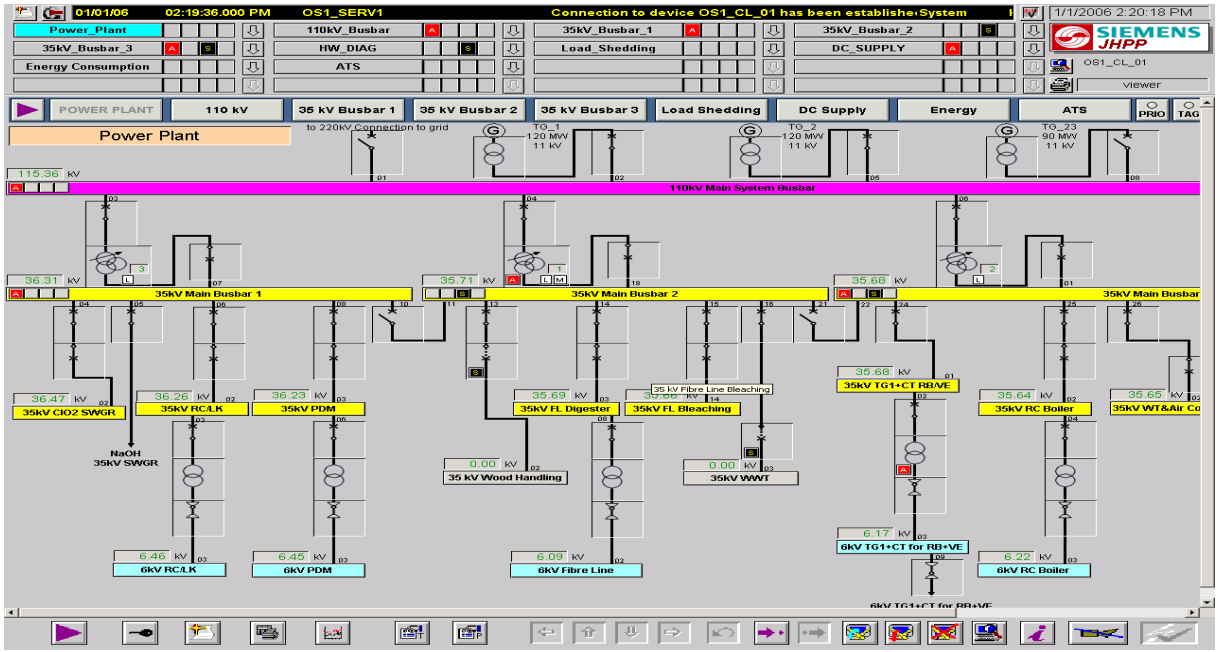

Figure 1: Pulp mill electrical system.

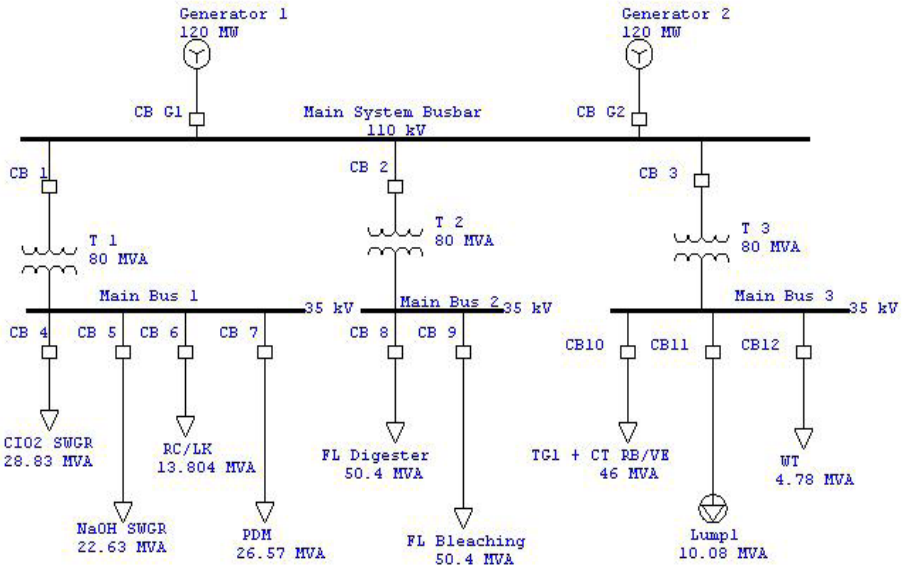

Figure 2: The one line diagram of the pulp mill electrical system using ETAP.

PULP MILL INFORMATION

For this paper, the load shedding scheme in a pulp mill is being studied. Figure 1 illustrates the electric power system of the pulp mill. Basically, the pulp mill electrical system can be divided into a few parts such as:

1 3-phase, 50Hz voltage level
   High voltage : 110kVac
   Medium voltage : 35kVac and 6kVac
   Low voltage : 690Vac and 400Vac
2 3×Turbine generator: 2×120MW+90MW=330MW and the connection to 220kV grid system.

The studies of application of AHP and fuzzy AHP will be conducted based on the information given as shown in Figure 1. The connection from the system to the grid had been tripped and the connection of the 90MW generator had been cut off. The generator is overloaded. In such circumstances, the load shedding scheme is activated. There are three main bus bars in the pulp mill electrical system. However, the bus bar 3 contains the RC boiler is having exception from the load shedding scheme. The boiler plays an important role in power recovery [31]. This is because the boiler will keep generating the steam for the steam turbo generator in order to make sure those operations of others equipments do not come to a halt.

In the analysis of the load effect, the circuit in Figure 1 can be designed by using electrical engineering power system analysis software, ETAP. The circuit in ETAP is shown in Figure 2. The information of the operating loads and estimation of power required for each area are shown in Table 1.

From Table 1, there are 25 areas in total. However, the analysis of the load shedding will only be done in those areas as in Figure 1. In addition, the operating load and estimation of area power will be filtered if both of the values are not significant. For an example, the load for RC/LK is 8MW in total and the estimation power of RC/LK is 13.8MW. Both values are less significant if compared with CIO2 REC, NaOH REC, PDM and FL. For the bus bar 3, it is important in power recovery process, thus it will not be included in the load shedding analysis. For those areas that are not in Figure 1 will not be considered in the load shedding scheme analysis.

RESULTS AND ANALYSIS

Analytic Hierarchy Process

From the Table 1, there are 7 information of the pulp mill listed. They are area, estimation of area power, Siemens load list, load factor, estimation of operating load power, LV motor and HV motor. For the area, it is essential for the analysis because it can clarify which part of the electrical system is facing problems. Estimation of area power is the information of power that delivered to the area. For the estimation of operating load power, it shows how much is the output power of that area. On the other hand, the Siemens load list will only work with Siemens software and hence, it does not included in the load shedding analysis. The same goes to load factor, most of the area has the same value. For the LV and HV motor, the availability of the motor will only affect the reactive power. Generally, name of the area, estimation of area power and estimation of operating load power are the key points in load shedding scheme.

Table 1: The pulp mill loading estimation.

Mill Wide Loading Estimation							
No	***Area***	***MW***	***A***	***B***	***AxB***	***LV***	***HV***
1	RC	10.08	11.24	0.55	6.2	135	0
2	LK	3.724	3.236	0.55	1.8	80	0
3	ClO_2	1.088	1.088	0.55	0.6	45	0
4	ClO_2R	28.83	28.83	0.95	27.4	0	0
5	NaOH	2.328	2.328	0.55	1.3	102	0
6	NaOHR	22.63	22.638	0.95	21.5	0	0
7	CT	3.5	4.332	0.55	2.4	26	0
8	H_2SO_4	0.61	0.893	0.55	0.5	49	0
9	PC	0.384	0.384	0.55	0.2	42	0
10	O_2	5.253	8.831	0.55	4.9	28	0
11	WT	4.78	5.825	0.55	3.2	105	0
12	WWT	5	3.883	0.55	2.1	120	3
13	Comp	2.347	2.347	0.55	1.3	10	0
14	RB	30.5	22.88	0.55	12.6	303	9
15	VE	7.245	7.245	0.55	4.0	54	0
16	MB	13.139	13.08	0.55	7.2	123	6
17	TG1	0.8445	0.8445	0.55	0.5	35	0
18	TG2	0.4885	0.4885	0.55	0.3	21	0
19	TG3	0.246	0.246	0.55	0.1	17	0
20	COAL	3	3	0.55	1.7	40	0
21	CTVE	6.725	14.877	0.55	8.2	20	6
22	CTTG	8.249	15.161	0.55	8.3	25	4
23	WH	11.2	7.06	0.55	3.9	259	0
24	PDM	26.57	31.572	0.55	17.4	621	11
25	FL	50.4	37.45	0.55	20.6	290	6
TOTAL		***249***	***249***		***158.0***	***2550***	***45***

* *MW = Area power in Megawatt (MW)*
* *A = Siemens load list*
* *B = Load factor*
* *AxB = Estimate operating load*
* *LV = Low voltage motor*
* HV = High voltage motor

From the key points selected, estimation of area power and estimation of operating load will be the criteria for the load shedding analysis. In the meantime, the alternatives of the criteria can also be determined. As discussed in Section II, there 4 areas that more significant which are CIO2 REC, NaOH REC, PDM and FL. Hence, the criteria and alternatives of the system have fulfilled the conditions for AHP analysis. The relationship of the parameters can be illustrated as in Figure 3.

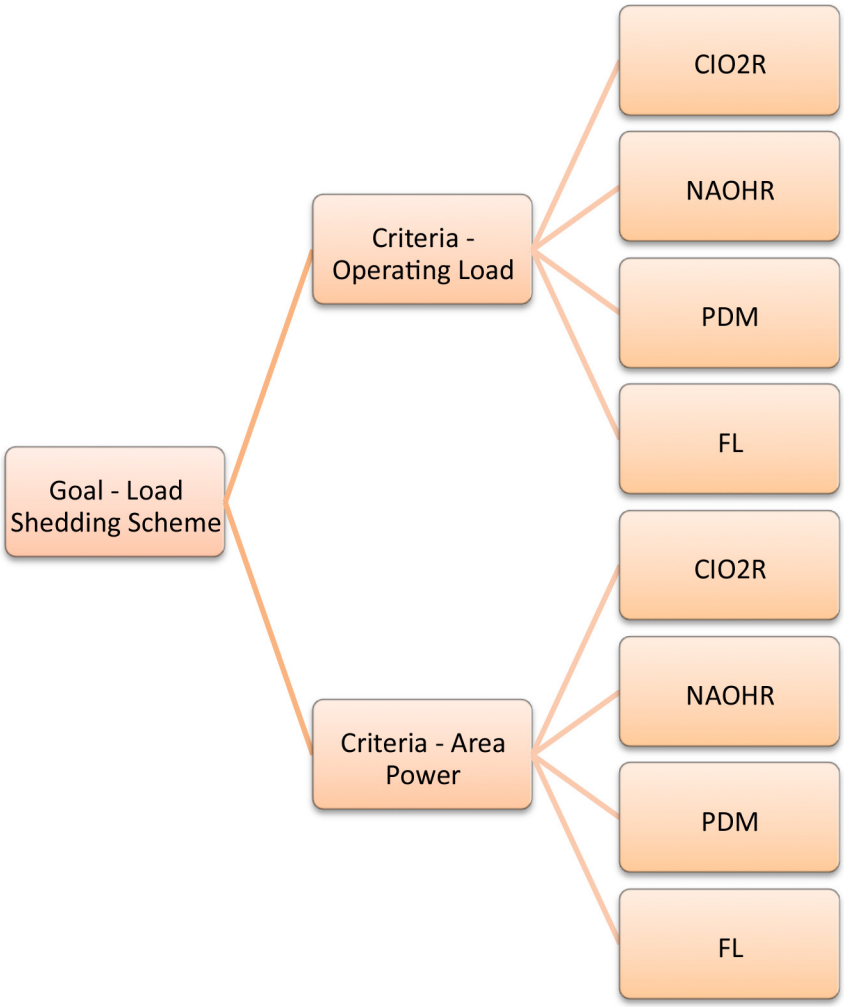

Figure 3: The hierarchy of load shedding scheme.

By using the calculation of the AHP, the importance of the criteria for operating load and area power are shown in Figure 4 and Figure 5 respectively.

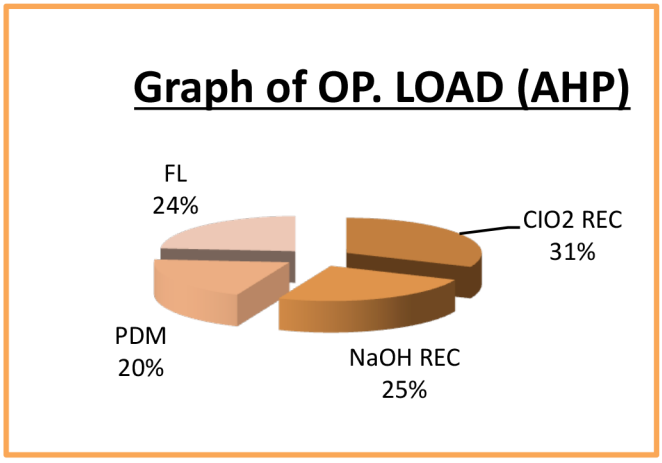

Figure 4: Percentage of alternatives in operating load.

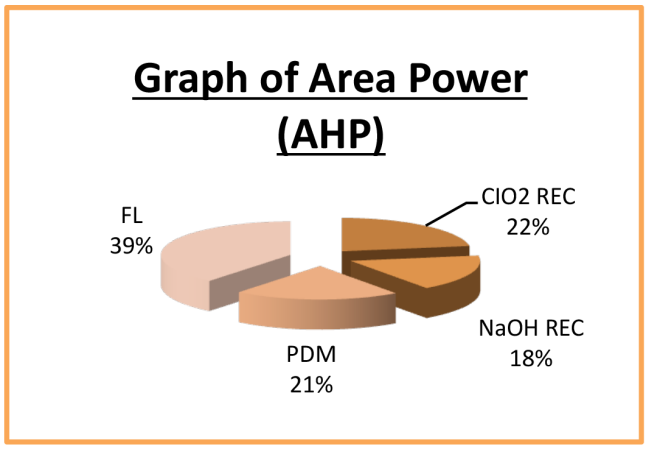

Figure 5: Percentage of alternatives in area power.

The calculation for the overall importance of the criteria can be illustrated in the flow chart as shown in Figure 6.

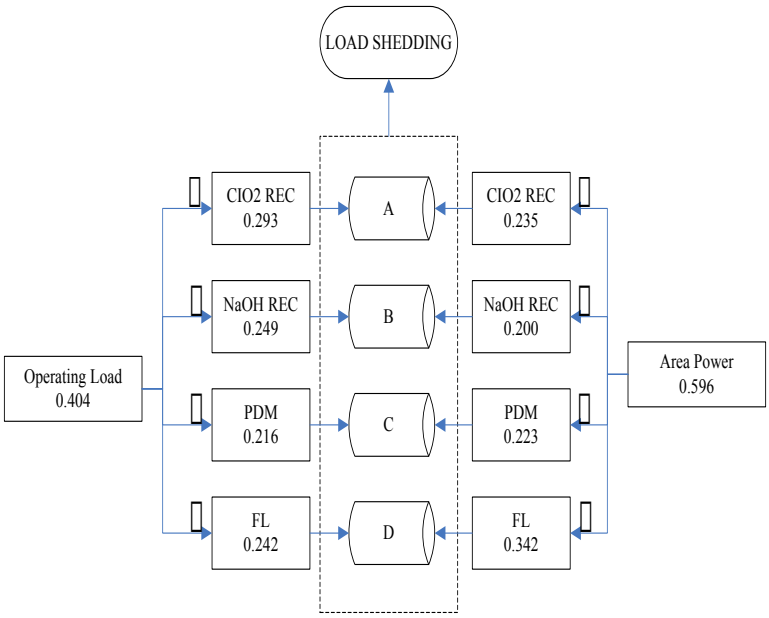

Figure 6: The overall results of the load shedding scheme by using AHP.

The load shedding scheme for the pulp mill will be triggered during the voltage unstable according to the load ranking determined by the AHP analysis. The sequence of the load to be shed can be tabulated in Table 2.

Table 2: The load ranking of the criteria using AHP.

Criterion	Load ranking	Weight
FL	1	30.1%
ClO2REC	2	25.8%
PDM	3	22.0%
NaOH REC	4	22.0%

The FL load with the highest percentage of load under overall consideration will be the first load to be shed. On the other hand, the CIO2 REC with overall performance of 25.8% will be the second load to be shed. If the generator of the pulp mill still insufficient to supply the power, the third load should be shut down. Due to both PDM load and NaOH REC load have the same percentage of load, either one of the loads can be shed as the third load. For this case, let the PDM as the third load to be shed.

Fuzzy Analytic Hierarchy Process

Fuzzy AHP is the extended analysis in order to analyze the data in vague situation. Sometimes, the data obtained might be fuzzy and is hard to determine the importance of the criteria or alternatives. Thus, the fuzzy AHP is specially derived to calculate the priority of the data according to the fuzziness of data. For this paper, let the α-cut or also known as value of fuzziness, $a = 0.5$. The value of α is ranging from 0 to 1 which means very uncertain and certain, respectively. $a = 0.5$ is chosen in this paper because the performance of fuzzy AHP under vague condition need to be studied. So, for the most secure analysis, 0.5 is the most suitable value for α-cut. The normalized weight for each criterion is tabulated in Table 3.

Table 3: The normalised weight of criteria.

Normalised weight of	Weight
Operating load	0.42
Area Power	0.58

After a series of calculation by using fuzzy AHP method, the weights of alternatives under operating load and area power are shown in Figure 7 and Figure 8.

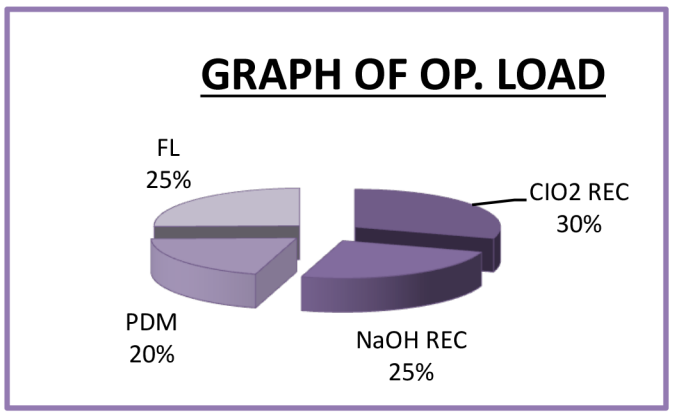

Figure 7: The weight of alternatives under operating load.

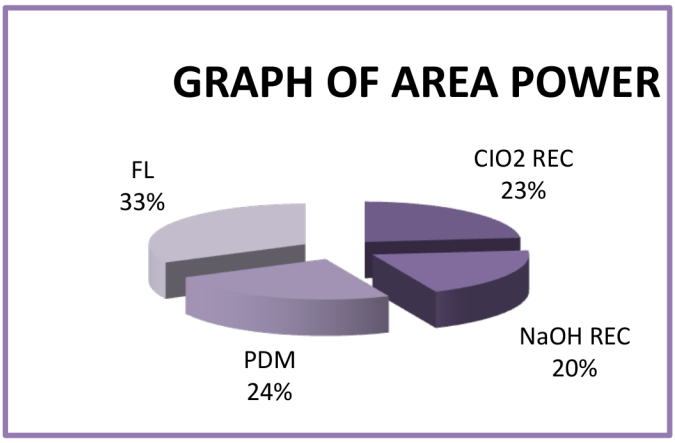

Figure 8: The weight of alternatives under area power.

In the load ranking to be applied in the load shedding scheme, the overall hierarchy diagram can be done by using the mathematic arithmetic operation. The arithmetic operation for fuzzy AHP can be shown in Figure 9 and the priority of the load can be tabulated in Table 3.

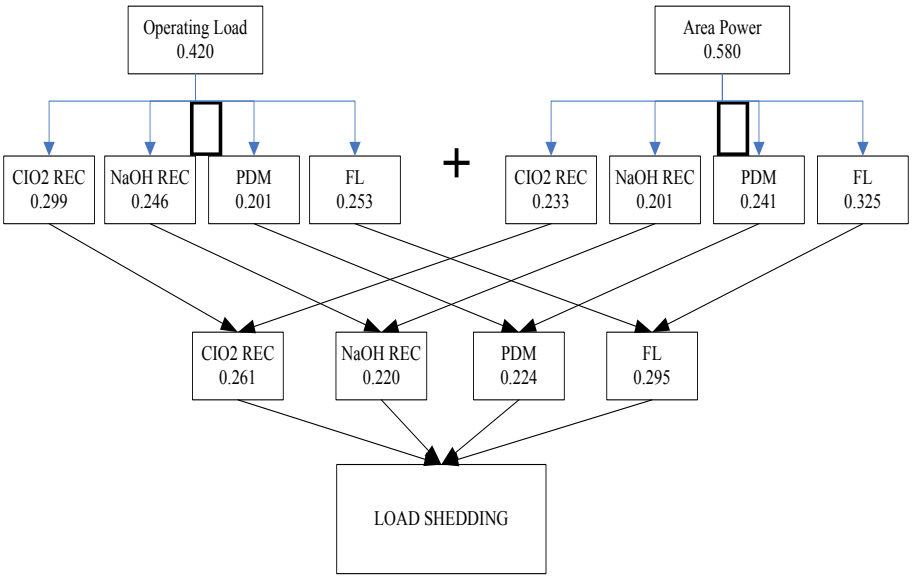

Figure 9: The overall hierarchy diagram for fuzzy AHP analysis.

Table 3: The load ranking of the criteria using fuzzy AHP.

Criterion	Load ranking	Weight
FL	1	29.5%
CIO2REC	2	26.1%
PDM	3	22.4%
NaOH REC	4	22.0%

As the result, the FL load obtained the highest priority of order in load shedding scheme. The FL load covered 29.5% of power if compared with other loads. Besides, the CIO2 REC load still remains the second priority as in AHP analysis. The remaining loads have similar percentage of priority which are NaOH REC and PDM.

DISCUSSION

From the AHP analysis, FL load is consumed the most electric power. Although the operating load of the FL load is not the highest, it contributes to the most power consumption in such area. It needs 30.1% of electric power. Even though CIO2 REC takes the highest percentage of operating power; it only consumes 25.8% of the overall power. In the meantime, PDM and NaOH REC are having the same percentage in overall power consumption which is 22%.

On the other hand, FL load had 29.5% of power consumption under fuzzy AHP analysis. CIO2 REC had 26.1% from the overall power consumption whereas PDM and NaOH REC had 22.4% and 22.0% respectively. In such circumstances, FL load has the most priority in load shedding scheme since both methods have the same result. If the load shedding action performance is not enough to overcome the overloading, CIO2 REC can be the next curtailment. According to the analysis had been done, PDM and NaOH REC are having an almost the same percentage. It is possible that either one of the loads can be chosen in order to alleviate the overloading of generator.

Generally, AHP analysis is faster and more convenient when compared with fuzzy AHP analysis. The calculations in AHP are simpler than in fuzzy AHP. In addition, the consistency ratio can be determined in order to obtain the result accurately. However, fuzzy AHP can determine the performance of criteria even when there is a vague condition. The fuzziness of the evaluation can be taken into consideration by using α-cut. This is useful for such evaluation which has limited data and condition.

CONCLUSIONS

In conclusion, the loads priority in load shedding scheme is successfully selected by using AHP and fuzzy AHP. Even though the formulas of calculation are different; both of the analysis methods are related one with another. AHP is a good multi decision making method and can be apply in any field of study whereas fuzzy AHP can determine the priority under vagueness condition. Load shedding scheme providers might use these approaches to determine the preceding load to be shed. Data of each branch or area will be collected by using software and the operators or engineers can take the proper action in handling the problems.

The whole AHP and fuzzy AHP processes apply basic calculations in selecting the load based on a few criteria and alternatives. Both methods help to capture subjective and objective evaluation measurements. There are a lot of factors that will affect the load shedding scheme. Thus, AHP and fuzzy AHP introduced to the load shedding scheme for electrical system in a pulp mill is beneficial to either consumers or developers.

ACKNOWLEDGEMENT

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H.H. Goh
Department of Electrical Power Engineering
Faculty of Electrical and Electronic Engineering
Universiti Tun Hussien Onn Malaysia
86400 Parit Raja, Batu Pahat, Malaysia
E-mail address: hhgoh@uthm.edu.my

S.W.Lee
B.C. Kok
Department of Electrical Power Engineering
Faculty of Electrical and Electronic Engineering
Universiti Tun Hussien Onn Malaysia
86400 Parit Raja, Batu Pahat, Malaysia

K.C.Goh
T.W.Seow
Department of Construction Management
Faculty of Technology Management & Business
Universiti Tun Hussein Onn Malaysia
86400 Parit Raja, Batu Pahat, Johor, Malaysia

K.T.K.Teo
Universiti Malaysia Sabah
88400 Kota Kinabalu, Sabah, Malaysia

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Observer-Based-Controller for Inverted Pendulum Model

M. H. Jali, H. Sarkawi & T.A.Izzuddin

ABSTRACT

This paper presents a state space control technique for inverted pendulum system. The system is a common classical control problem that has been widely used to test multiple control algorithms because of its nonlinear and unstable behavior. Full state feedback based on pole placement and optimal control is applied to the inverted pendulum system to achieve desired design specification which are 4 seconds settling time and 5% overshoot. The simulation and optimization of the full state feedback controller based on pole placement and optimal control techniques as well as the performance comparison between these techniques is described comprehensively. The comparison is made to choose the most suitable technique for the system that have the best trade-off between settling time and overshoot. Besides that, the observer design is analyzed to see the effect of pole location and noise present in the system.

Keywords: Full state feedback, inverted pendulum, observer, optimal control

ABSTRAK

Kajian ini membentangkan keadaan ruang teknik kawalan untuk sistem bandul songsang. Sistem ini adalah masalah kawalan klasik yang telah digunakan secara meluas untuk menguji pelbagai algoritma kawalan kerana tingkah laku linear dan tidak stabil. Suap balik keadaan penuh berdasarkan penempatan tiang dan kawalan optimum digunakan untuk sistem bandul songsang untuk mencapai spesifikasi reka bentuk yang dikehendaki iaitu 4 saat penyelesaian masa dan 5% lajakan. Simulasi dan kaedah pengoptimuman pengawal suapbalik keadaan penuh berdasarkan teknik penempatan tiang dan kawalan optimum serta perbandingan prestasi antarateknik-teknik yang diterangkan secara menyeluruh. Perbandingan ini dibuat untuk memilih teknik yang paling sesuai untuk sistem bandul songsang yang mempunyai keseimbangan terbaik di antara penyelesaian masa dan lajakan. Selain itu, reka bentuk pemerhati dianalisis untuk melihat kesan lokasi tiang dan gangguan di dalamsistem tersebut.

Kata kunci:Suap balikpenuh,bandulsongsang,pemerhati,kawalan optimum

INTRODUCTION

Inverted pendulum system is a classic problem that has been widely used to test multiple control algorithms because of its nonlinear, unstable and non-minimum phase characteristic. The system features in commonwith space booster and balancing transportation system [1]. The system has been commonly used as a benchmark to analyze advanced control strategies in order to investigate the advantages and disadvantages each of them.

Full state feedback controller based on pole placement and optimal control technique has been commonly applied in the inverted pendulum system. However there are limited sources that have investigated which one of these control techniques that are more suitable particularly for the inverted pendulum application. Therefore the motivation of this research is to determine the technique that is preferable for the inverted pendulum system as well as optimizing the control techniques to achieve the best performance.

This paper is organized as follows. Section II describes in detail about the inverted pendulum system. Section III explains thoroughly the control techniques that involved in the research works. Section IV presents the results and discussion of each control technique as well as the comparison among them using Matlab/Simulink simulation. Finally, Section V describes the conclusion of this research work.

Inverted Pendulum

Inverted pendulum system can be described with simplified free body diagram of the cart and pendulum in which the dynamic system is modeled via Newton's Laws of motion. The system model needs to be represented in state space form before designing the controller [2][3]. Fig. 1 shows a simplified diagram of inverted pendulum system. In the analysis the pendulum is balanced upward although the pendulum's natural position is to point downwards from the pivot point. This mechanism can be realized by moving the cart in horizontal direction by applying the exerted force by a small motor on it [4]. The pendulum is maintained at the upright position by altering the position of the cart. It is assumed that the rod is massless and the pendulum mass is concentrated at the end of the rod [5].

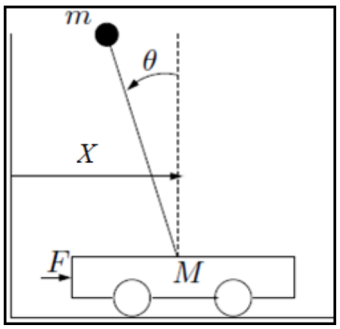

Fig. 1: Inverted pendulum system illustration [6]

Firstly, component of state vector selection need to be minimized. The system has to be described thoroughly and completely in a minimum number of state variables. Secondly the components of state vector must be linearly independent [7]. In this system, the state variables represent the position and velocity of the cart (x and $\dot{x}$) as well as angle and angular rate of the pendulum (θ and $\dot{\theta}$). The force applied in horizontal direction (F) to the cart represents the input while cart's position and pendulum's angle represent the outputs.Eventually by linearizing the term $cos\ \theta = -1$, $sin\ \theta = -\theta$ and by neglecting higher order term into the state space equation, the linear state space form is;

$$\begin{bmatrix}\dot{x}\\ \dot{\theta}\\ \ddot{x}\\ \ddot{\theta}\end{bmatrix}=\begin{bmatrix}0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ 0 & \frac{m^2gl^2}{J(M+m)+Mml^2} & \frac{-(J+ml^2)b}{J(M+m)+Mml^2} & 0\\ 0 & \frac{mgl(M+m)}{J(M+m)+Mml^2} & \frac{-mlb}{J(M+m)+Mml^2} & 0\end{bmatrix}\begin{bmatrix}x\\ \theta\\ \dot{x}\\ \dot{\theta}\end{bmatrix}+\begin{bmatrix}0\\ 0\\ \frac{J+ml^2}{J(M+m)+Mml^2}\\ \frac{ml}{J(M+m)+Mml^2}\end{bmatrix}u \quad y=\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\end{bmatrix}x$$

The value of the parameter in the state space form is assumed to be as stated in Table I.

Table I: The parameter's value of inverted pendulum

No.	Parameter	Value
1	*Mass of cart(M)*	0.65kg
2	*Mass of pendulum(m)*	0.18 kg
3	*Viscous friction of the cart(b)*	0.15 N/m/sec
4	*Length of pendulum center of mass(l)*	0.25 m
5	*Inertia of the pendulum(J)*	0.005 kg*m^2

Thus, linear state space forms to get the following state space equation;

$$\begin{bmatrix}\dot{x}\\ \dot{\theta}\\ \ddot{x}\\ \ddot{\theta}\end{bmatrix}=\begin{bmatrix}0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ 0 & 1.7313 & -0.2126 & 0\\ 0 & 31.9328 & -0.5889 & 0\end{bmatrix}\begin{bmatrix}x\\ \theta\\ \dot{x}\\ \dot{\theta}\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 1.4177\\ 3.9258\end{bmatrix}u \quad , \quad y=\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\end{bmatrix}x$$

THE CONTROL TECHNIQUES

Pole placement technique

Desired characteristic equation is derived by using the design specification of settling time and overshoot. These design specifications will produce second order equation. The system needs to produce desired characteristic equation that has four poles because it is fourth pole system. Thus another 2 poles need to be determined in order to make the controller faster. The second order equation from the design specification determines the location of the two dominant poles. The other 2 non dominant poles are placed in suitable location using pole placement technique [5].Hence, by considering overshoot and settling time design target as shown in Table II [7][8].

Table II: Design specification

No.	Design target	Cart position	Pendulum angle
1	Settling time	4 seconds	4 seconds
2	Overshoot	5%	5% x 2π=0.3142rad

From the design target, the desired dominant poles may be derived as follow;

$$\xi = \frac{-\ln(Os\%/100)}{\sqrt{\pi^2 + \ln^2(Os\%/100)}} = \frac{-\ln(0.05)}{\sqrt{\pi^2 + \ln^2(0.05)}} = 0.69 \quad , \quad ts = \frac{4}{\zeta\omega n} \Rightarrow \omega n = \frac{4}{\zeta ts} = \frac{4}{(0.69)(4)} = 1.45$$

$$S_1, S_2 = -\zeta\omega n \pm j\omega n\sqrt{1-\zeta^2} = -0.69(1.45) \pm j1.45\sqrt{1-0.69^2} = -1 \pm j$$

Table III: Non-dominant poles location's gain

No.	Pole location	K_1	K_2	K_3	K_4
1	$-10 \pm 10j$	−10.4	73.534	−11.59	9.73
2	$-30 \pm 30j$	−93.57	531.51	−96.84	50.71
3	$-60 \pm 60j$	−374.27	2038.97	−380.68	168.5
4	$-100 \pm 100j$	−1039.65	5580.48	−114.55	92.77

Hence, the best pole location that produce the best output results need to be investigated. The poles are relocated at a more negative eigenvalues location to see whether the output result might be improved or not. The simulation is performed based on the Simulink block diagram shown in Fig. 2. The controller gain is generated as Table III.

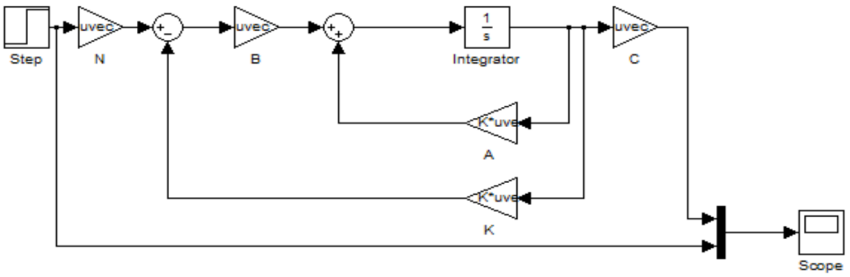

Fig. 2: Block diagram of full state feedback

Integral control technique

Integral control technique is known as tracking controller as it required output to follow input command signal. The feedback from output is feed forwarded to the controlled plant via integrator. The integrator also known as integral action is used to increase the system type and reduce the previous finite error to zero [7]. The configuration is shown in Fig. 3.

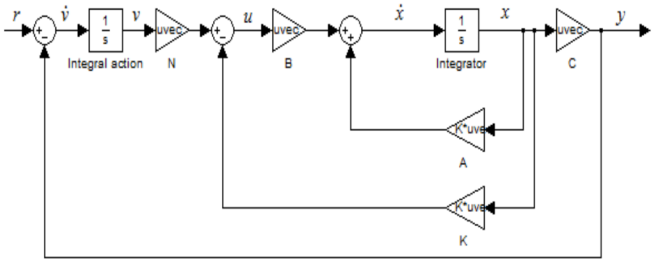

Fig. 3: Integral control technique configuration

Based on Fig. 3, the compensation system for the integral control technique becomes;

$$\begin{bmatrix}\dot{x}\\ \dot{v}\end{bmatrix}=\begin{bmatrix}A-BK & BN\\ -C & 0\end{bmatrix}\begin{bmatrix}x\\ v\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}r, \qquad y=\begin{bmatrix}C & 0\end{bmatrix}\begin{bmatrix}x\\ v\end{bmatrix}$$

By referring the compensation system, the type of system has been increased. For desired characteristic equation, there is additional pole [7]. Previous pole placement technique has revealed the best location for the 3rd and 4th pole location. Thus, the best location for the 5th non-dominant pole needs to be determined. Table IV illustrated the gain.

Table IV: The 5th non-dominant poles location's gain

No.	Pole location	K_1	K_2	K_3	K_4
1	–50	–4928	3067.05	–2767	1027.71
2	–80	–7828.58	4588.35	–4369	1613.9

Optimal control technique

The total energy of the system when undergone the transient response is called *transient energy*that can be specified in the objective function. *Control energy* is also included in the objective function that needs to be minimized. Therefore the objective function can be formulated by time integral of total transient energy and control energy expressed as a function of time [9]. The *control energy* is expressed as $u^T(t)Ru(t)$ while *transient energy* is expressed as $x^T(t)Qx(t)$.

$$J=\int_0^\infty\left[x^T(t)Qx(t)+u^T(t)Ru(t)\right]dt$$

The matrix Q and R is a weighting functions that determine the relative importance of the error and the expenditure of the transient energy and the control energy. The cost function can be solved using Ricatti equation with respect to K;

$$A^TP+PA-PBR^{-1}B^TP+Q=0$$

Matrix P can be obtained by solving the Ricatti equation. The optimal feedback gain K is defined as;

$$u(t)=-Kx(t)=-R^{-1}B^TPx(t)$$

Since the objective is to drive the output to zero. Therefore cost function that contain $y^2(t)$ is needed [13]. Hence;

$y^2(t)=y^T(t)y(t)=x^T(t)C^TCx(t)=x^T(t)Qx(t)$, where $Q=C^TC$, therefore the quadratic function appearsnaturally.

The objectives are to improve settling time and overshoot. Therefore weighting function Q which is transient energy is optimized. Weighting function R remains to be constant. Based on the analysis, optimizing the value q_1 of weighting matrix Q will improve the performance. Therefore, the gain based on q_1 value is generated as Table V.

Table V: Several values q_1 and their optimal gain

No.	q_1	K_1	K_2	K_3	K_4
1	100	-10	37.429	-7.89	6.94
2	500	-22.36	53.21	-14.49	9.97
3	1000	-31.62	63.82	-19.11	12.01

Observer design

In real practice, not all state variables are available for measurement. For the inverted pendulum system only one or two state variables are directly measured. The other two variables need to be estimated using state observer.

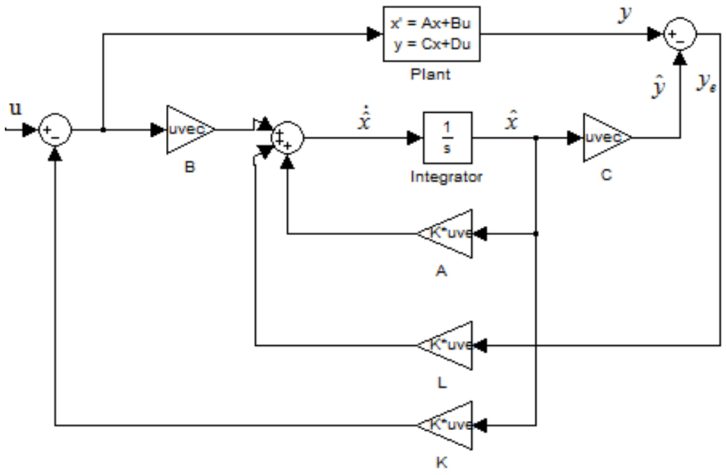

Fig. 4: Full state feedback controller with observer

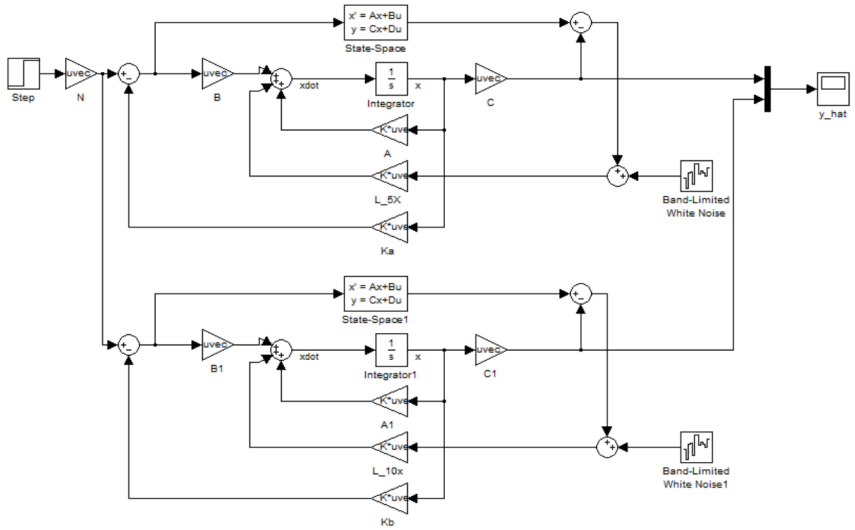

Fig. 5: Block diagram of observers with additional noise source

Based on separation principle, it is obvious that the state feedback controller and observer design is independent of each other. Therefore they can be designed separately to form observer-state feedback control system [14][9]. From the comparison of the control techniques analysis, the best controller gain will be implemented to the observer-state feedback control design.The effect of selection of the observer pole and the effect of noise present to the observer is investigated. The noise that is added to the observer is known as a band limited white noise source block. In the simulation, the intensity of the noise at 10^{-8} is selected [9]. The Simulink block diagram of the full state feedback based on observer state is shown on Fig. 4 while the block diagram of the additional noise source block is shown in Fig. 5. The observer gain that is implemented to the controller is shown in Table VI.

Table VI: Observer gain

Pole location	L_1	L_2	L_3	L_4
5 times dominant poles	109.79	33796.33	6058.6	256513.33
10 times dominant poles	219.79	258201.5	24185.2	2757216.74

RESULTS AND DISCUSSION

Full state feedback based on pole placement technique

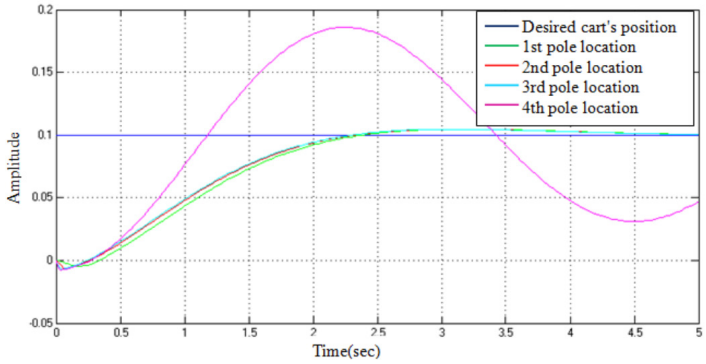

Fig. 6: Cart's positiongraph

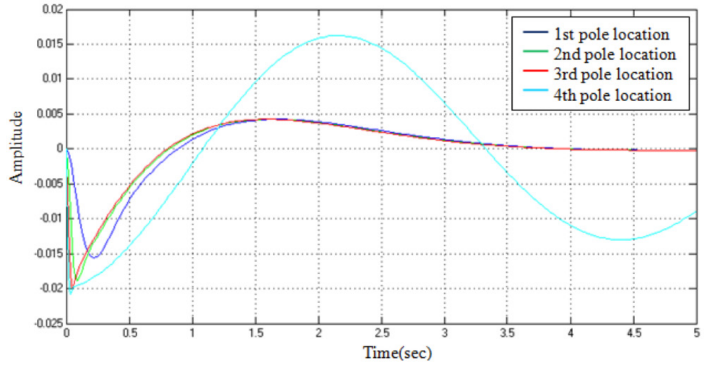

Fig. 7: Pendulum angle graph

From Fig. 6, the cart's position results are about the same which are 5 seconds for settling time and 5% overshoot except for the 4th pole location which has a very large overshoot that reach 80% and settling time more than 40 seconds. Therefore selection need to be done between the other three poles location based on the pendulum angle output results.

From Fig. 7, non-dominant poles at 1st pole location ($-10 \pm 10j$), 2nd pole location ($-30 \pm 30j$) and 3rd pole location ($-60 \pm 60j$) have about similar transient response which have settling time about 4 seconds and overshoot about 0.004rad. Non dominant poles at 4th pole location ($-100 \pm 100j$) produce a very slow settling time that reach more than 40 seconds and a large overshoot. Therefore the pole can be placed either at 2nd pole location or 3rd pole location. Since the waveforms are about the same, the 2nd pole location is chosen because it has the best trade-off between the cart's position and pendulum's angle result. The results are shown in Table VII.

Table VII: Output Results of The Non Dominant Poles

No.	Pole location	Settling Time		Overshoot	
		Cart Position	Pendulum angle	Cart Position	Pendulum angle
1	$-10 \pm 10j$	5 sec	4 sec	5%	0.004
2	$-30 \pm 30j$	5 sec	4 sec	5%	0.004
3	$-60 \pm 60j$	5 sec	4 sec	5%	0.004
4	$-100 \pm 100j$	>40 sec	>40sec	80%	0.016

In the next section, the pole placement with integral action technique isanalyzed.

Full state feedback based on integral control technique

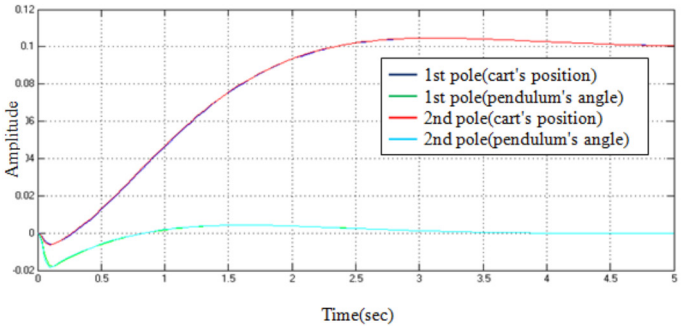

Fig. 8: Comparison between the non-dominant poles

From Fig. 8, any farther distance of the non-dominant pole location will not produce significant difference to the output results. Therefore, the 5th non dominant pole is chosen at 1st pole location (-50) because it is an optimized pole location for this integral control technique. Next the performance of the optimal control technique will be analyzed.

Full state feedback based on optimal control technique

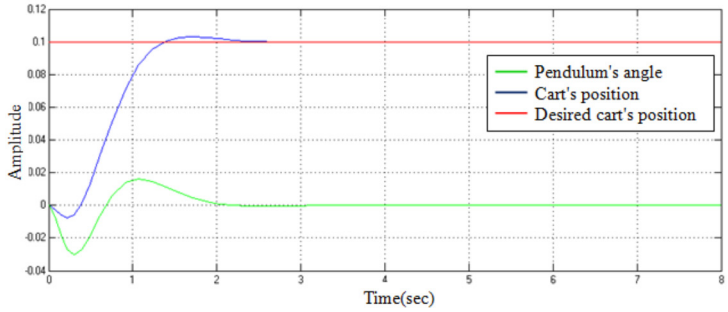

Fig. 9: Output results when q_1=100 and q_2=1

From Figure 9, the overshoot and settling time of cart's position is less than 5% and 2.5 seconds and pendulum's angle has overshoot and settling time less than 0.02rad and 2 seconds. Next is the output when value q_1 =1 and q_2 =100.

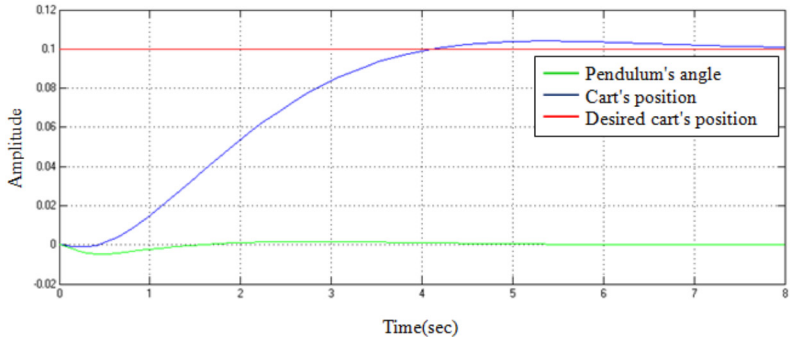

Fig. 10: Output results when q_1=1 and q_2=100

From Fig.10, the overshoot is within range but the settling time for cart's position is about 8 seconds and for pendulum's angle is about 5 seconds which are worse compare to the default value. Therefore adjusting value $q_{2\,of}$ weighting matrix Q will not improve the output performance from the original cost function. Next the comparison of difference q_1 value is done to determine the best performance.

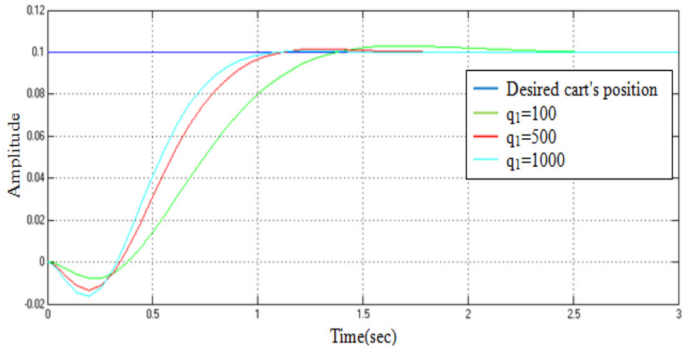

Fig. 11: Cart's position outputs

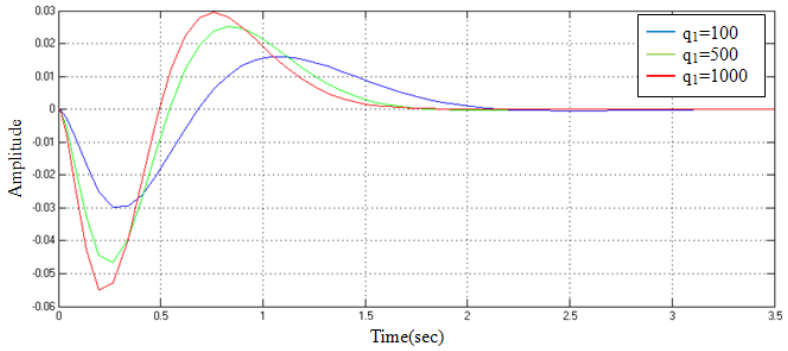

Fig. 12: Pendulum angle outputs

Refer to the Fig.11, the settling time is about 2.5 seconds when q_1=100 and about 1.75 seconds when q_1=500 and 1.5seconds when q_1=1000. The overshoots are all about the same that are about 5%.Refer to Fig.12, the settling time is about 3 seconds when q_1 100 and about 2 seconds when q_1 500 and 1000. The overshoot when q_1 =100 is 0.015rad, q_1 =500 is 0.025rad and q_1 1000 is 0.03rad. The performance when q_1 =500 and q_1 =1000 are about the same. Therefore, the best choice is at value q_1 =500 because it has the best trade-off between settling time and overshoot. The summary is shown in Table VIII.

Table VIII: Comparison of the output result

No	q_1 value	Settling Time		Overshoot	
		Cart Position	Pendulum angle	Cart Position	Pendulum angle(rad)
1	100	2.5 sec	3 sec	4%	0.015rad
2	500	1.75 sec	2 sec	4%	0.025rad
3	1000	1.5 sec	2 sec	4%	0.03rad

Next section is the comparison between the control techniquesto select the best technique for the system.

Comparison between control technique

In this section the performances of the control techniques is compared to select the best control technique.

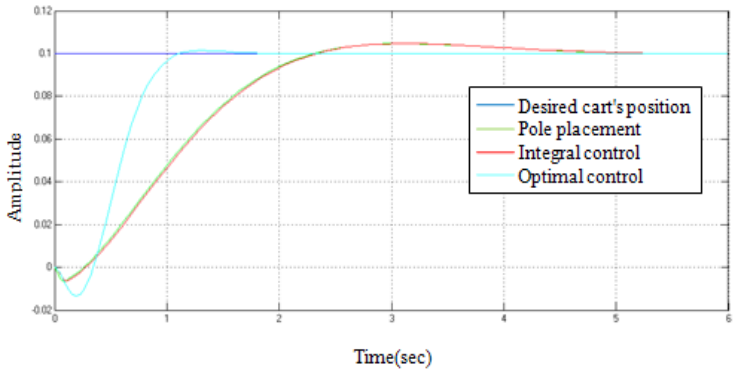

Fig. 13: Cart's position outputs

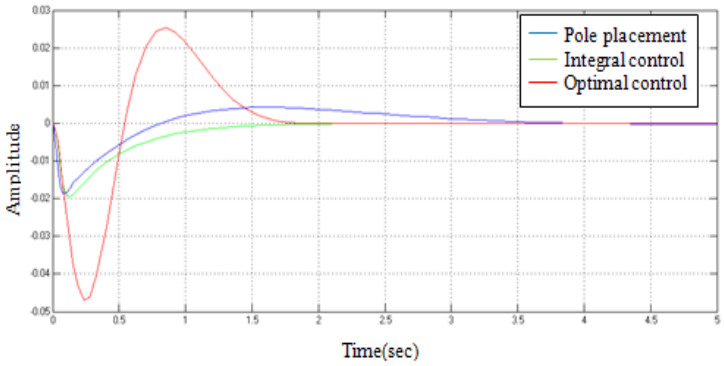

Fig. 14: Pendulum's angle outputs

Based on Fig.13, the pole placement and integral control technique has about the same output which are 5 seconds settling time and 5% overshoot. Optimal control has superiority in term of settling time which is about 1.75 seconds and zero overshoot.Based on Fig.14, pole placement technique has settling time about 3.5 seconds and overshoot about 0.004rad. Integral control has a faster settling time that is about 2 seconds and almost zero overshoot percentage. Optimal technique has settling time about the same as integral control that is 2 seconds and overshoots about 0.025rad.

As a summary, the best trade-off between these three control techniques is optimal control technique because all the output graphs are within the design target which is 4 seconds for settling time, 5% overshoot for cart's position and 0.3142 rad for pendulum's angle. The comparison is shown in Table IX.

Table IX: Comparison between the three control techniques

No	Control Technique	Settling Time		Overshoot	
		Cart Position	Pendulum angle	Cart Position	Pendulum angle(rad)
1	Pole placement	5 sec	4 sec	5%	0.004
2	Integral control	5 sec	2 sec	5%	0
3	Optimal control	1.75 sec	2 sec	4%	0.025

Next section is the state feedback controller based on the observer state will be discussed.

Full state feedback controller based on observer state

The initial condition of the plant is set to 0.05 to see how the observer drives the error to zero to achieve the desired output.Let take a close look in the first 0.05 seconds as depicted in Fig.15, the observer output is converging to emulate the plant output. The observer makes correction to drive the error to zero and converge slowly to actual state [7].

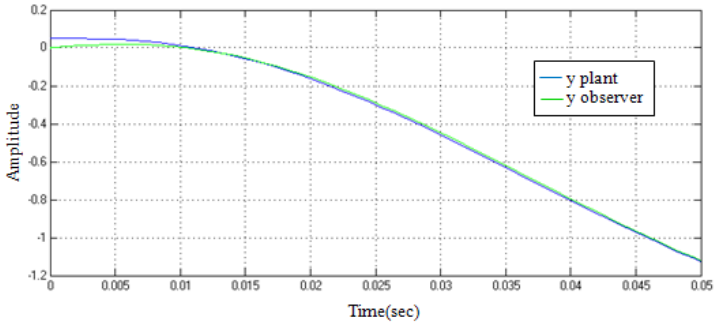

Fig. 15: Plant and observer output result in the first 0.05 seconds

Let investigate the effect of observer pole to the estimated state.

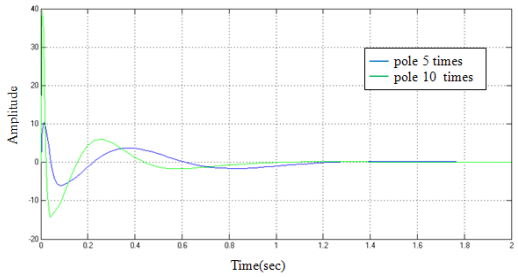

Fig. 16: Estimated state for cart's position

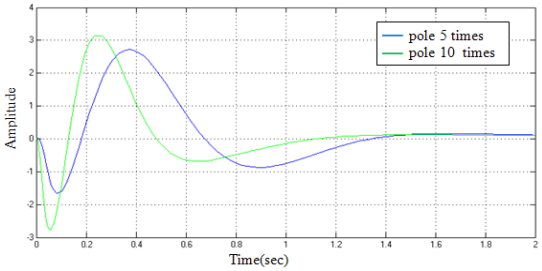

Fig.17: Estimated state for pendulum angle

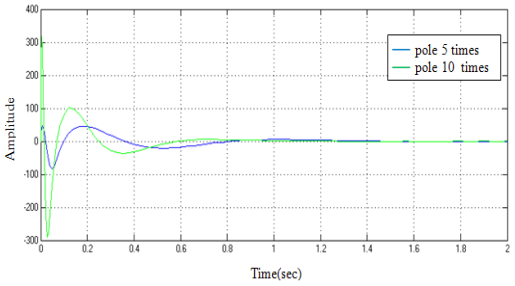

Fig. 18: Estimated state for cart's velocity

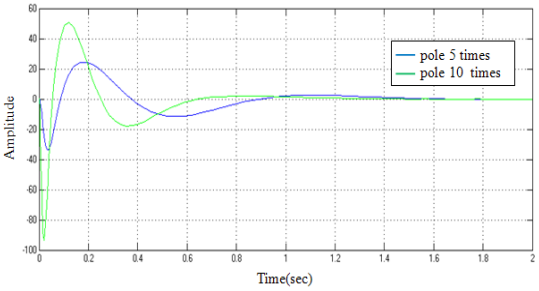

Fig. 19: Estimated state for pendulum's angular rate

Based on Fig.16 to 19, it can be concluded that observer poles that 10 times distance from the dominant poles at the left hand side is faster than poles that 5 times distance from the dominant poles. The estimated states settle at the steady state value faster when the observer poles are located at the more negative values. Therefore the poles that is located 10 times distance from dominant poles can be denoted as fast observer and the other one as slow observer.

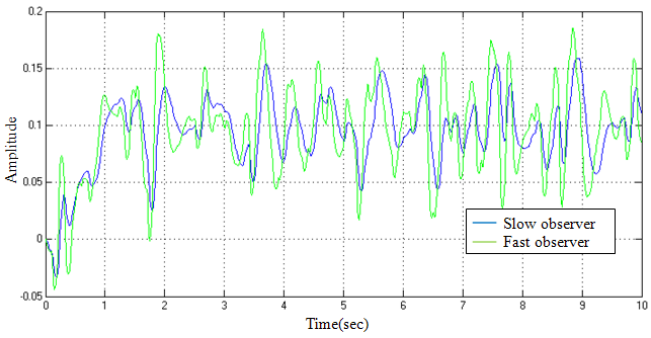

Fig. 20: Output result with noise of slow observer and fast observer

From Fig.20, effect of noise to the slow and fast observer can be concluded. In the design, the observer poles that have the best trade-off between decay rate and noise sensitivity is crucially important. Fast observer is more sensitive to noise than slow observer as such the observer tracks the state superimposed with noise [5]. Besides that, fast observer has smaller filtering ability but less sensitive to change of plant parameters compared to slow observer. The deviation of the estimated output from the true value of the slow observer is smaller than fast observer. [15].

CONCLUSION

Based on the simulation results, the optimal control technique is found to be the best control technique for the inverted pendulum system. It is capable to achieve the desired performance target that has the best trade-off between the settling time and overshoot. Thus the technique provides a fast and accurate control system which is the main criteria for the inverted pendulum system operation. The full state feedback based on estimation state simulation result has shown that the farther the observer pole location at the left hand side of the s plane, the faster the observer behaved. However the faster observer is prone to the noise present in the system. Therefore the best trade-off between the decay rate that realized the speed of the observer and the noise sensitivity need to be determined.

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M. H. Jali
Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
mohd.hafiz@utem.edu.my(06-5552331)

H. Sarkawi
Faculty of Electronics and Computer Engineering
UniversitiTeknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
hafez@utem.edu.my(06-5552112)

T.A.Izzuddin
Faculty of Electrical Engineering
UniversitiTeknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
tarmizi@utem.edu.my(06-5552361)

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Effect of Processing Temperature and Time on Properties of Poly (ethylene-co-vinyl acetate)/reclaimed Rubber Blends

Suganti Ramarad, C. T. Ratnam, Mohd Khalid & T.G. Chuah

ABSTRACT

This study aims to evaluate the feasibility to blend reclaimed rubber (RR) with poly(ethylene-co-vinyl acetate) (EVA) and effects of different processing time and temperature on the mechanical and thermal properties of the blends. Blends with 30 and 70% RR were successfully produced using BrabenderPlasticoder (PL2000-6). The processing temperature was ranged between 110 to 150 °C while processing time was ranged between 5 to 20 minutes. Tensile strength and modulus were found to be optimum between 120 to 130 °C whereas elongation at break increased marginally with increasing processing temperature for 30% RR blend. However, no distinct changes on tensile properties were observed with 30% RR blend on increasing processing time. Meanwhile for 70% RR blend all tensile properties remained unchanged with increase in processing temperature and time. Isothermal thermogravimetry analysis at 120 and 150 °C showed negligible weight loss (< 1%) after an hour for all samples. Dynamic thermogravimetry analysis of EVA and RR both showed two step degradation process. The blends however, showed intermediate thermal stability. This preliminary work supports the feasibility of making RR blends to produce thermoplastic elastomers. Thermal stability of the blends can be further improved by introducing vulcanization into the matrices.

ABSTRAK

Penyelidikan ini bertujuan menentukan kebolehcampuranpoli (etilena-covinilacetat (EVA) dan getah ditebus (RR) dan kesan masa dan suhu pencampuran yang berbeza terhadap sifat mekanikal dan termaladunan. Adunan dengan 30% dan 70% RR telah Berjaya dihasil dengan Brabender Plasticoder (PL2000-6).Suhu pencampuran telah ditetapkan diantara 110 hingga 150 °C manakala masa pencampuran ditetapkan diantara 5 hingga 20 minit. Kekuatan dan modulustensil didapati optimum diantara 120 dan 130 °C sementara pemanjangan takat putus meningkat secara tipis dengan peningkatan suhu pencampuran bagi adunan 30% RR. Walaubagaimanapun, tiada perubahan ketara pada sifat tensil yang diperhatikan bagi adunan 30% RR dengan peningkatan masa pencampuran. Manakala bagi adunan 70% RR semua sifat-sifat tensil tetap tidak berubah dengan peningkatan suhu dan masa pencampuran. Analisa termogravime triisotermal pada 120 °C dan 150 °C menunjukkan penurunan berat (< 1% berat) yang boleh diabaikan selepas satu jam bagi semua sampel. Analisa thermogravimetri dinamik bagi EVA dan RR menunjukkan proses degradasi dua langkah. Walaubagaimanapun, adunan menunjukkan kestabilan termal diantara EVA dan RR.Kajian permulaan ini menyokong kemampuan menghasil adunan RR bagi menghasilkan termoplastik elastomer. Kestabilan termal adunan boleh ditambah baik dengan memperkenalkan penaut-silangan ke dalam matriks.

KEYWORDS: Waste tire rubber, reclaimed rubber, recycling, EVA, blends.

INTRODUCTION

Increasing awareness on the environmental safety coupled with new sets of rules and regulation has driven the recycling and reuse of polymeric materials(Adhikari et al., 2000). This is due to nature of polymeric materials which does not decompose easily, whereby the disposal of this polymeric material causing serious environmental problems. One such polymeric product is tires made of rubber. Sienkiewicz et al. (2012) quoted the annual global production of tires is some 1.4 billion units, which corresponds to an estimated 17 million tonnes of used tires each year in Europe. Many ways has been adopted to recycle and reuse waste tire to address this problem. Shulman (2011) in his work, detailed the main treatments and technologies used to recycle and reuse tires and the corresponding application of the recyclates. He categorized one of the applications for waste tires are to be incorporated into thermoplastic polymeric material to obtain "thermoplastic elastomer" by combining rubber elasticity and thermoplastic matrix properties.

Reclaimed rubber from waste tires has since found use to be incorporated into thermoplastic elastomer as it can be processed, compounded and revulcanized in the same way as fresh rubber (Al-Malaika and Amir, 1989). Furthermore, advantages of using reclaim rubber along with fresh rubber system are easier breakdown, shorter mixing time, lower power consumption during breakdown and mixing, influence in curing and aging, cost and energy saving (Adhikari et al., 2000). A large number of studies have been carried out on the blends of natural rubber and reclaimed rubber (De et al., 2000, Kumnuantip and Sombatsompop, 2003, Rattanasom et al., 2005). However, only a small number of studies have been carried out on blends of reclaimed rubber and widely available polyolefin such as polypropylene and polyethylene (Sonnier et al., 2006, Zhu and Tzoganakis, 2010).

Ethylene-vinyl acetate (EVA) copolymers have been used in many applications due to their vinyl acetate (VA) content. For example, copolymers with low VA content (<20%) are usually employed as thermoplastic and those with a higher VA content are used as oil-resistance elastomer (Tanrattanakul and Kaewprakob, 2011). Blends of thermoplastic EVA with natural rubber have been widely reported (Jansen and Soares, 1996, Koshy et al., 1993, Mohamad et al., 2006). Most of them are reporting at an approximate blend ratio of 40:60 or 50:50, the blend of natural rubber:EVA exist as continuous phase, producing co-continuous morphology. Prominent properties were also observed at the said blend ration, indicating that the phase inversion occurred. This finding can be used as a strong supporting reason to venture into a study of blend containing EVA and reclaimed rubber.

EXPERIMENTAL

Materials

Poly(ethylene-co-vinyl acetate), EVA (Grade EVA N8045) having 18% vinyl acetate content with melt flow index, MFI, value of 2.3 g/10 min and density of 0.947 g/cm^{3}was purchased from the TPI POLENA Public Company Limited, Thailand. Reclaimed rubber, RR (RECLAIM Rubberplas C) from waste heavy duty tires used in this study was supplied by RubplastSdn. Bhd., Malaysia. General properties of RR are 48% rubber hydrocarbon, 5% ash content, 15% acetone extract, 25% carbon black fillers and density of 1.3 g/cm^3.

Mixing Procedure

Two different blends of EVA/RR as designated in Table 1 were prepared for this study. Five different temperatures ranging from 110 ºC to 150 ºC was used to study the effects of processing temperature on the blends (mixing time was set at 10 minutes). Processing time was varied at 5, 10, 15 and 20 minutes (mixing temperature was set at 120 °C). The blending was done using BrabenderPlasticoder (PL2000-6) at 50 rpm. EVA was charged into the mixing chamber and allowed to melt for 2 minutes before adding RR while allowing the mixing to continue untilaffixed processing time. The prepared blends were compression moulded in an electrically heated hydraulic press into 1mm thick sheets under 14.7 MPa at 130 ºC for a total of six minutes (3 minutes of pre-heating, 20 seconds of venting and 3 minutes of compression). The sheets were immediately cooled between two platen of a cold press at 20 ºC for two minutes.

TABLE 1: Designation of samples

Sample designation	EVA content (%)	RR content (%)
7E3R	70	30
3E7R	30	70

Tensile Properties

Tensile test was done in accordance with ASTM D412 on Toyoseiki tensile testing machine. Crosshead speed of 50 mm/min was used. The samples were prepared according to ASTM D412 type 3 specifications. The test specimen thickness is 1 mm and variation did not exceed ±2%. The standard test piece were cut using Wallace die cutter. Minimum of 5 samples were used for tensile test and an average of results was taken as the resultant.

The effect of different processing temperature and time on tensile fracture surface morphology of the blends was studied using Field Emission Scanning Electron Microscopy (FESEM).

Thermal analysis

Thermal decomposition behaviour of blends processed at different temperature and time was studied using thermo gravimetric analysis (TGA) with Mettler Toledo Analyzer. Thermograms of approximately 10 mg samples were recorded from room temperature to 600 °C at a heating rate of 10 C/min under Nitrogen atmosphere. Isothermal behaviour of blend was also studies at 120 °C and 150 °C under Nitrogen atmosphere for 60 minutes to report the extent of degradation associated with temperature and time.

RESULTS AND DISCUSSION

Tensile properties

The effect of processing temperature and time of EVA/RR blends on tensile properties are shown in Figure 1. For 7E3R blend, tensile strength and elongation at break properties showed 120 °C to be optimum while modulus was optimum at 130 °C; whereas no distinct changes was observed

on 3E7R blend for effect of processing temperature. Processing time of 5 to 20 minutes of both blends does not influence any tensile properties as shown in Figure 1. Figure 2 and 3 supports the tensile study findings where all tensile fracture surfaces showed similar mode of failure. All samples showed extensive ductile fracture behaviour with fine fibril structure formation. 7E3R blends showed longer fibril formation compared to 3E7R blends. It was also obvious to note spaces between rubber particles and EVA matrix (shown with arrow) as this indicates incompatibility of the blends. There were also voids indicating rubber particle detachment from EVA matrix.

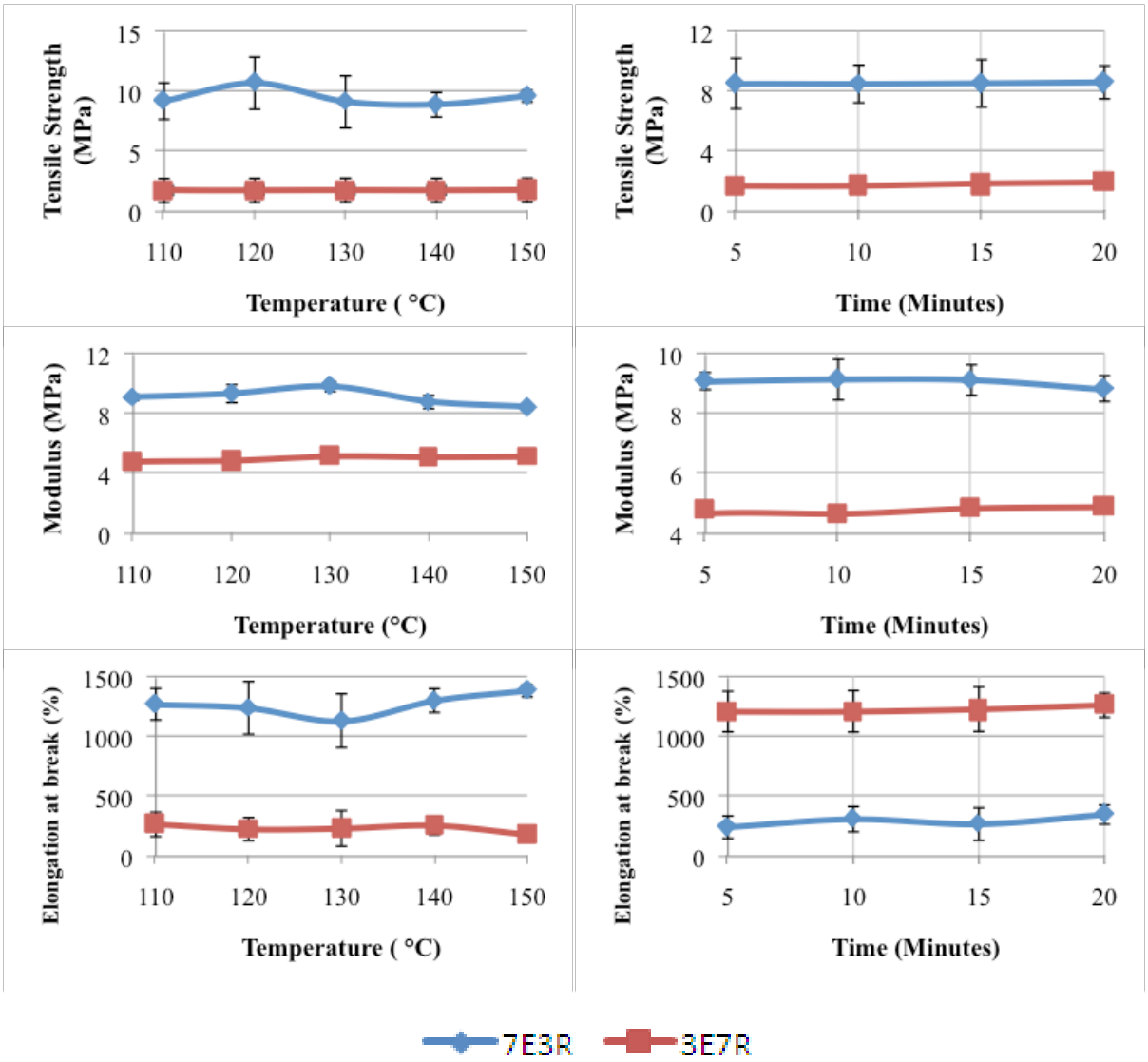

FIGURE 1: Effect of processing temperature and time on tensile strength, modulus and elongation at break of 7E3R (30% RR) and 3E7R (70% RR) blends.

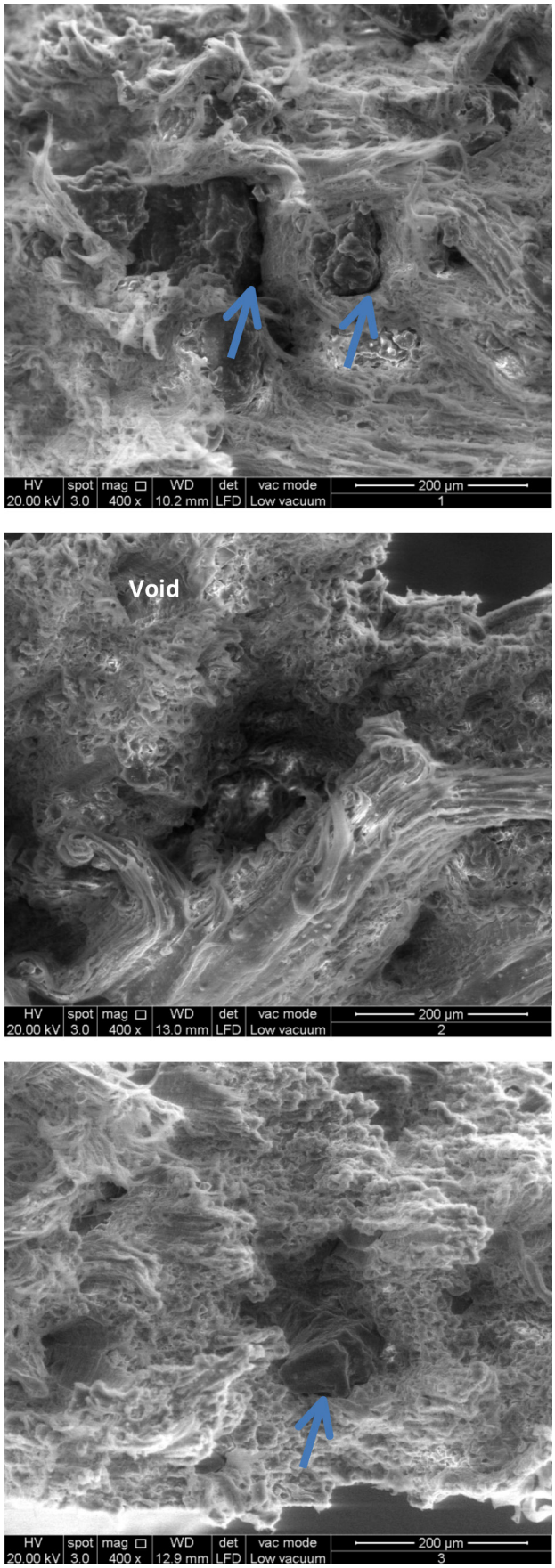

FIGURE 2: SEM micrograph of 7E3R blend for a) 5 minutes, 120 °C b) 10 minutes, 120 °C and c) 150 °C, 5 minutes processing condition.

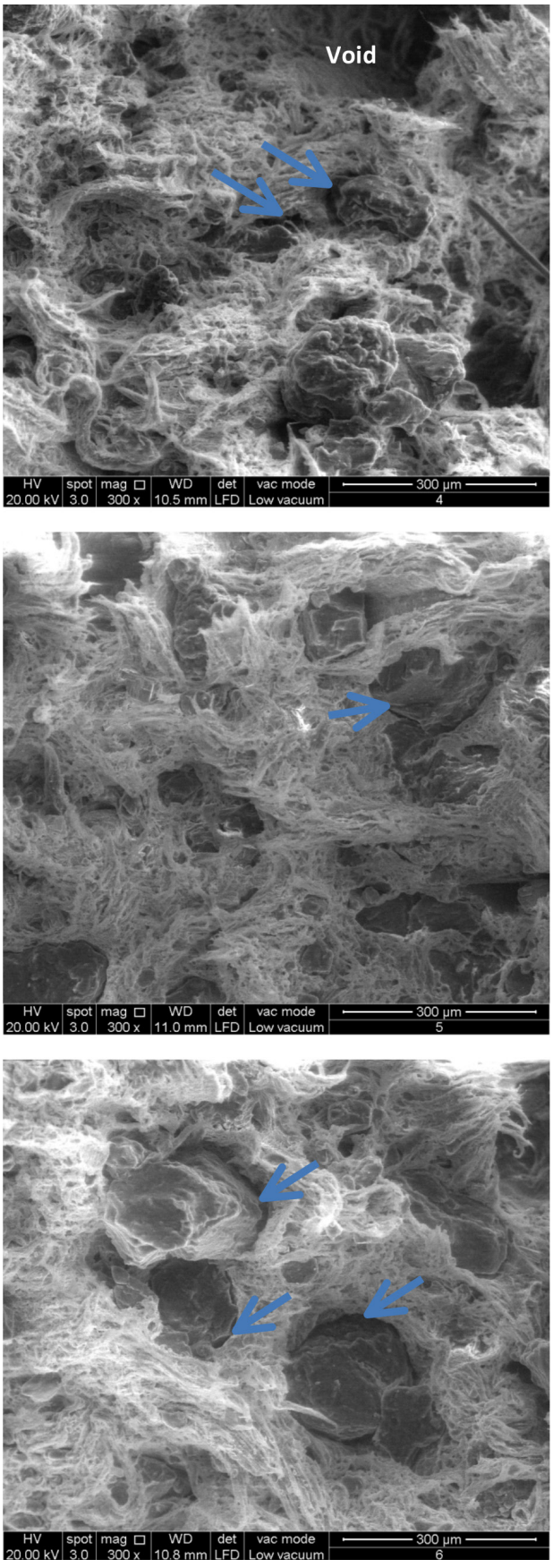

FIGURE 3: SEM micrograph of 3E7R blend for a) 5 minutes, 120 °C b) 10 minutes, 120 °C and c) 150 °C, 5 minutes processing condition

Thermal analysis

Figure 4 shows the isothermal thermograms of EVA, RR, 7E3R and 3E7R at 120 °C and 150 °C for the first 60 minutes. Findings show that negligible weight loss of less than 0.5 wt% at both studied temperature. Furthermore, negligible weight loss of less than 0.2 wt% and 0.3 wt% at 10 and 20 minutes show that samples of EVA and RR can be processed up to

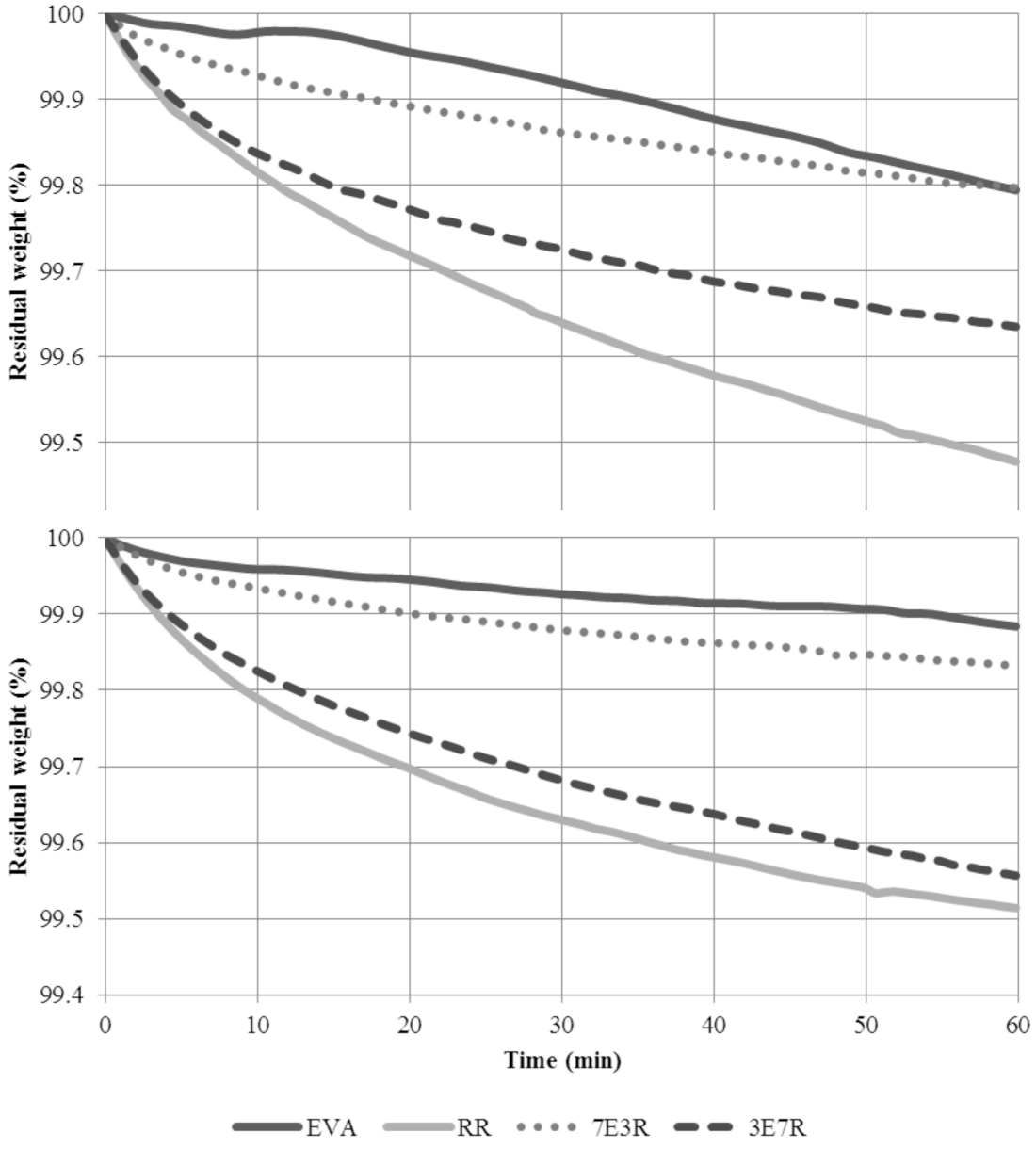

FIGURE 4: Isothermal thermograms of controls and blends at a) 120 °C and b) 150 °C

20 minutes without extensive degradation occurring. These findings further support the tensile finding which did not change substantially with increasing processing time.

Figure 5 shows the TGA curve for EVA, RR, 7E3R and 3E7R. Two step degradation was observed for all samples. Table 2 lists the data obtained from TGA curve and derivative TGA curve. EVA undergoes two step degradation, where the first step is associated with loss of acetic acid group and the second one corresponding to the degradation of main chain, polyethylene backbone. RR also undergoes two step degradation which starts rather early at 171 °C. First degradation

range could be associated with the breakdown of pre-existing vulcanisation crosslinking such as links formed by sulphur, zinc oxide and steric acid. Second degradation process could be associated with intensive thermal depolymerisation of the rubber backbone. It is interesting to note the residual weight of RR to be 51 wt%. The residual weight is char of filler, additives and impurities from waste tire such as carbon black. This residual weight here corresponds well with the supplier information where only 48% of the RR is rubber hydrocarbon.

The blends also shows similar 2 step degradation step shown by EVA and RR, however they appear to be having an intermediate thermal stability. Both blends showed better thermal stability compared to RR. At higher EVA content (7E3R sample) thermal stability of sample are better than that of EVA. This might suggest physical compatibility of EVA with RR caused by molecular level mixing during compounding process.

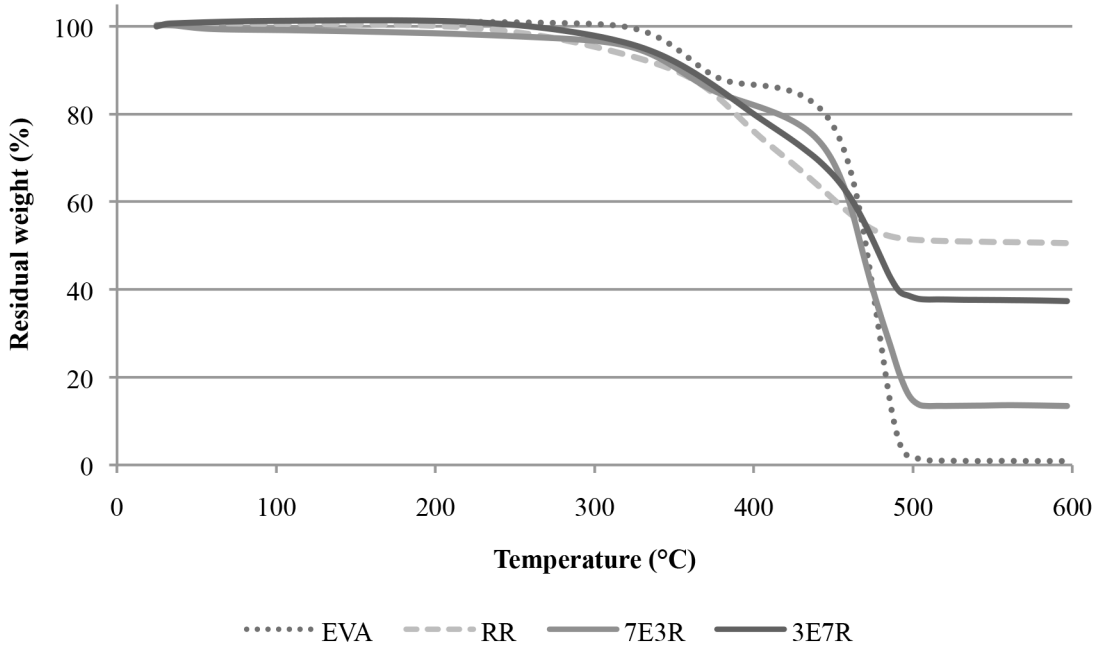

FIGURE 5: TGA curve for controls and blends

TABLE 2: Degradation temperature and residual weight of EVA, RR and blends.

Sample designation	1st degradation			2nd degradation			Residual wt (%)
	Start	Peak	End	Start	Peak	End	
EVA	319	361	388	388	478	505	0.9
7E3R	311	369	398	398	474, 497	509	13
3E7R	194	393	416	416	480, 485	503	37
RR	171	393	416	416	445	491	51

CONCLUSION

EVA/RR blends can be processed at temperature between 120 °C to 130 °C without fear of degradation. Processing time of 5 to 20 minutes does not influence the tensile properties of EVA/RR blends. Incorporation of RR improves the thermal stability of EVA/RR blends.

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Suganti Ramarad*
Division of Manufacturing and Industrial Processes
Faculty of Engineering, University of Nottingham Malaysia Campus
Jalan Broga,43500 Semenyih, Selangor, Malaysia

C. T. Ratnam
Radiation Processing Technology Division
Malaysian Nuclear Agency (Nuclear Malaysia)
Bangi, 43000 Kajang, Selangor, Malaysia

T.G. Chuah
Department of Chemical & Environmental Engineering
Faculty of Engineering, University Putra Malaysia (UPM)
UPM Serdang, Selangor, Malaysia

**Correspondence to: SugantiRamarad (suga4u2c@gmail.com)*

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Application of Pearson Density Function Approximation in Performance Evaluation of Micro Grid Photovoltaic Standalone System

E.A. Azrulhisham, K.P. Zakaria, M. Fairus Humar & W. Mustafa

ABSTRACT

Solar energy is considered as one of the solution to the worldwide depletion of fossil fuel resources as well as the economic alternatives in protecting the atmosphere from the adverse consequences of global warming. Nevertheless solar power is often criticized because the output power generated is variable and virtually uncontrollable. Potential analysis on introduction of photovoltaic power generation system at particular site however requires the knowledge of solar radiation and photovoltaic power distributions. The work presented in this paper considers the possibility of using higher order statistical moments in solar radiation and photovoltaic power distribution approximation. Applying the first to forth statistical moments, the density function approximation was obtained using the Pearson system. This method is based on the relationship between the first four moments of the distribution where the probability distribution is estimated by equating their theoretical moments with the moments of empirical distributions. Application of various statistical moments has the advantage in estimating the potential of photovoltaic power generation system in view of dynamic changes of skewness and kurtosis coefficients of solar radiation and solar power distributions.

Keywords: Pearson System, Density Function Approximation, Photovoltaic Standalone System, Solar Radiation, Solar Power

ABSTRAK

Tenaga solar merupakan salah satu penyelesaian yang boleh diambil di dalam menangani masalah kekurangan sumber bahan api berasaskan fosil di samping sebagai alternatif di dalam melindungi persekitaran daripada kesan-kesan buruk pemanasan global. Walau bagaimanapun kuasa solar sering dikritik disebabkan oleh kuasa yang dijana adalah tidak tetap dan tidak dapat dikawal sepenuhnya. Analisis potensi di dalam pengenalan suatu sistem penjanaan kuasa fotovolta bagi kawasan tertentu memerlukan pengetahuan tentang taburan-taburan radiasi solar serta kuasa fotovolta. Hasil kerja yang dibentangkan ini memberi fokus kepada penggunaan momen statistik peringkat tinggi di dalam penghampiran taburan radiasi solar serta kuasa fotovolta. Menggunakan momen-momen statistik pertama hingga keempat, penghampiran fungsi ketumpatan diperolehi menggunakan sistem Pearson. Kaedah ini adalah berasaskan hubungan di antara empat momen-momen pertama bagi taburan di mana penganggaran taburan kebarangkalian dibuat dengan menyamakan momen-momen teori dan momen-momen taburan empirik. Penggunaan pelbagai momen-momen statistik mempunyai kelebihan di dalam penganggaran potensi bagi sistem penjanaan kuasa fotovolta di mana perubahan-perubahan dinamik pekali-pekali kepencongan dan kurtosis bagi taburan radiasi solar perlu diambil kira.

Katakunci: Sistem Pearson, Penghampiran Fungsi Ketumpatan, Sistem Lengkap Fotovolta, Radiasi Solar, Kuasa Solar

INTRODUCTION

Deciding on which distribution to use for operation and performance modeling is a common issue in system performance evaluation and risk assessments. Currently there exists a considerable amount of literature on density forecast models but being able to decide on a suitable distribution even for preliminary analysis has remained a substantial problem. Conventional modeling techniques are largely relies on the mean-variance analysis but it has been well suggested by numbers of research that the observed performance distributions are not always fully captured by the first two moments of the distribution (Andreev, Kanto and Malo, 2007). The motivation for modeling skewness and kurtosis, especially in power production system has followed from attempts to understand the system performance based on various statistical moments. Cheng et al. (Cheng, Hou and Wu, 2005), among others, have proposed that performance of a wind turbine is related to dynamic changes of skewness and kurtosis coefficients of the turbine's output parameters distribution. The evidence for various relationships between statistical higher moments of observed parameter distribution and the system performance has consequently stimulated a line of research attempting to incorporate skewness and kurtosis in the power system performance evaluation (Billinton and Allan, 1996). Given the needs in handling variety shapes of random samples, it has become interesting to propose frameworks that are flexible enough to accommodate distributions with broad range of properties. This paper is aimed to provide further insight into the power system performance evaluation based on distribution selected from the Pearson family. The Pearson system is a parametric family of continuous probability distributions capable to model a wide scale of distributions with various skewness and kurtosis (Hahn and Shapiro, 1967). Firstly introduced by Karl Pearson in 1895 as an effort to model visibly skewed distribution, the Pearson family of distribution is amendable to both theoretical and empirical problems where density function must be explicitly expressed.

In this study, probabilistic performance model of micro grid photovoltaic standalone system was evaluated considering global solar radiation and photovoltaic power stochastic properties. Distribution of produced energy characterized by variation of global solar radiation was then approximated using the Pearson system employing the first to fourth statistical moments.

THE PEARSON SYSTEM

The Pearson system is a parametric family of distributions used to model a broad scale of distributions with various third and fourth moments. This method of moments is a statistical technique to estimate probability distributions by equating their theoretical moments with the moments of empirical distributions. Pearson distributions are defined by a separable first order differential equation of

$$\frac{f'(x)}{x(x)} = \frac{P(x)}{Q(x)} = \frac{x-a}{b_0+b_1x+b_2x^2} \tag{1}$$

where *f* is a density function and *a, b0, b1* and *b2* are the parameters of the distribution. An important characteristic of the Pearson system is the direct correspondence between the parameters and the first four moments (μ1, ..., μ4) of the distribution (Stuart and Ord, 1994). The expressions for the moments are obtained by solving Equation 1 using integration by part.

The expressions for the parameters *a, b0, b1* and *b2* in terms of the first four moments can be obtained from the set of Equation (2).

$$
\begin{aligned}
b_1 = a &= -\frac{\mu_3\left(\mu_4 + 3\mu_2^2\right)}{A} = -\frac{\mu_2^{1/2}\beta_1\left(\beta_2 + 3\right)}{A'} \\
b_2 &= -\frac{\left(2\mu_2\mu_4 - 3\mu_3^2 - 6\mu_2^3\right)}{A} = -\frac{\left(2\beta_2 - 3\beta_1^2 - 6\right)}{A'} \\
b_0 &= -\frac{\mu_2\left(4\mu_2\mu_4 - 3\mu_3^2\right)}{A} = -\frac{\mu_2\left(4\beta_2 - 3\beta_1^2\right)}{A'}
\end{aligned}
\tag{2}
$$

where the two moment ratios

$$\beta_1^2 = \mu_3^2 / \mu_2^3$$

and

$$\beta_2 = \mu_4 / \mu_2^2$$

respectively denote skewness and kurtosis. The scaling parameters *A* and *A'*are obtained from

$$
\begin{aligned}
A &= 10\mu_4\mu_2 - 18\mu_2^3 - 12\mu_3^2 \\
A' &= 10\beta_2 - 18 - 12\beta_1^2
\end{aligned}
\tag{3}
$$

Classification and selection of the distribution are achieved by finding the roots of the denominator of quadratic Equation 1 and the Pearson's coefficient given by

$$K = \frac{b_1^2}{4b_0b_2} \tag{4}$$

Depending on the values of these parameters, different types of Pearson curves can be obtained such that

1. If $K < 0$, roots are real and of opposite signs. This corresponds to beta distribution or type-I distribution in the Pearson system.
2. If $K > 1$, roots are real and have the same sign. This corresponds to beta distribution of the second kind, or type-VI distribution.
3. If $0 < K < 1$, roots are complex. This corresponds to type IV-distribution.

Pearson proposed further class distinctions by taking into account certain distributions and boundaries between classes and classified the solutions into types numbered 1 to 12 (Andreev, Kanto and Malo, 2007). These were extended in an article by Johnson, et al. (1963) and the new tables of classification are reproduced in Pearson and Hartley (1962), together with examples of their use.

PROBABILISTIC PERFORMANCE MODEL

Random Performance Index

Performance statistic model of an electrical power generation system has important applications in conjunction with production costing and performance evaluation. In this study probabilistic performance model of a 20 kW micro grid photovoltaic standalone system was developed by considering the power production as random performance variable. A set of 2163 historical data representing 6 months global solar radiation and solar power production was obtained from a potential site at Kampung Lubuk Batu, Kemaman Terengganu. The analysis has been structured on the basis of the results obtained from the hourly observation of global solar radiation and the power produced by the system from 7am to 6pm. The descriptive statistic representing the mean μ, standard deviation σ, skewness β_1, and kurtosis β_2 of the global solar radiation and the photovoltaic power produced is shown in Table 1.

Table 1: Descriptive statistics of global solar radiation and photovoltaic power production

	Global Solar Radiation (kWh/m^2)	Photovoltaic Power Production (kW)
Mean	0.4563	7.3222
Standard Deviation	0.3085	4.9613
Skewness	0.2538	0.2769
Kurtosis	1.8533	1.8892

Distribution Fitting

The log likelihood value obtained by maximum likelihood estimation method (MLE) is calculated for several probability distributions in order to assess which probability distribution fits the observed global solar radiation and the photovoltaic power production. From a statistical point of view, MLE is considered to be the most robust of distribution parameter estimation techniques (Trivedi, 2002). Considering the large sample size of random variables the MLE is preferred due to asymptomatically efficiency of the technique in providing the most precise estimates (Press, et al., 1993).

The maximum likelihood estimators of a distribution type are the values of its parameters that produce the maximum joint probability density for the observed data. In the case of probability distribution, MLE maximize the actual probability of that distribution type being able to generate the observed data. The likelihood value is not constrained by a certain range of possible values and therefore cannot be used by itself to make a judgment about the fit of the distribution model. The likelihood value is used to compare the fit of multiple distributions where the distribution with the largest likelihood value is the best fit statistically.

The log likelihood Ψ values of several distributions obtained by MLE for the observed global solar radiation and the photovoltaic power production data is shown in Table 2.

Table 2: Log likelihood values

Distribution	Ψ, Global Solar Radiation	Ψ, Photovoltaic Power Production
Normal	-1057.86	-13154.2
Lognormal	-1176.24	-13242.7
Weibull	-639.787	-12723.8

Mean-variance Analysis

Considering the log likelihood Ψ values, the Weibull distribution exhibit the best of fit with both observed global solar radiation (GSR) and the photovoltaic power production (PV) data. Applying MLE the parameter estimates of the selected distribution are shown in Table 3.

Table 3: Distribution parameter estimates

	Parameter	**GSR**	**PV**
Normal	Mean	0.4563	7.3222
	Standard Deviation	0.3085	4.9613
Lognormal	Mean	-1.1442	1.6336
	Standard Deviation	0.9955	0.9884
Weibull	Shape	1.3897	1.3914
	Scale	0.4976	7.9887

Performances of a power generation system such as the mean power production are typically expressed as single numerical values. These numerical indices provide the expected values of the distributions that fully describe the particular indicator being expressed. The expected value of a distribution is one of its several parameters, which provide a complete mathematical description of the distribution function. This mean value alone does not, however, provide any information on the variability of the index being described. Therefore, an index of the system performance is best represented as a probability distribution, or probability density function (PDF) (Cross, Herman and Gaunt, 2006). In this study, the distribution parameters obtained from MLE is applied in illustrating PDF's of the observed data. Figure 1 shows the histogram of the observed data and the PDF of its fitted distributions.

Pearson System

Conventional distributions of normal, lognormal and Weibull are largely relies on the mean-variance analysis where the observed performance distributions are not always fully captured by the first two moments of the distribution. In order to handle variety distribution shapes of the observed global solar radiation and the photovoltaic power production data, the density function approximation was obtained using the Pearson system applying the first to forth statistical moments.

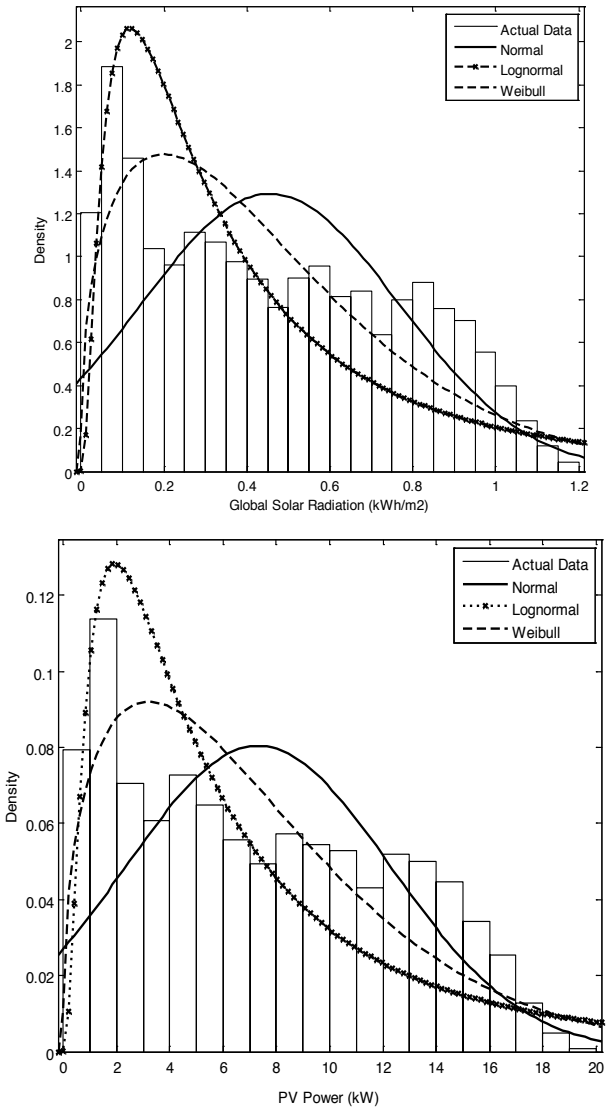

Figure 1: Histogram of the observed data and the PDF of its fitted distributions

The Pearson system which is a parametric family of distributions was utilized due to the capability of the system to model a broad scale of distributions with excellent accuracy (Hahn and Shapiro, 1967). Based on the first through fourth statistical moments, the type of the Pearson system was determined by Equation 4 and the quadratic roots which represent the Pearson's criterion for fixing the distribution family as shown in Table 4.

Table 4: Pearson's Criterion for Fixing the Distribution Family

	Global Solar Radiation	**Photovoltaic Power Production**
Pearson's Coefficient	-0.0211	-0.0258
Roots	1.9695; -1.4742	2.0489; -1.4883
Family of Distribution	Type I	Type I

Considering the Pearson's coefficient K < 0 and the roots are real and opposite sign the distribution of the observed global solar radiation and the photovoltaic power production data is classified as Type 1. The frequency curve for the type 1 Pearson's family of distribution for the observed global solar radiation and the photovoltaic power production data is shown in Figure 2.

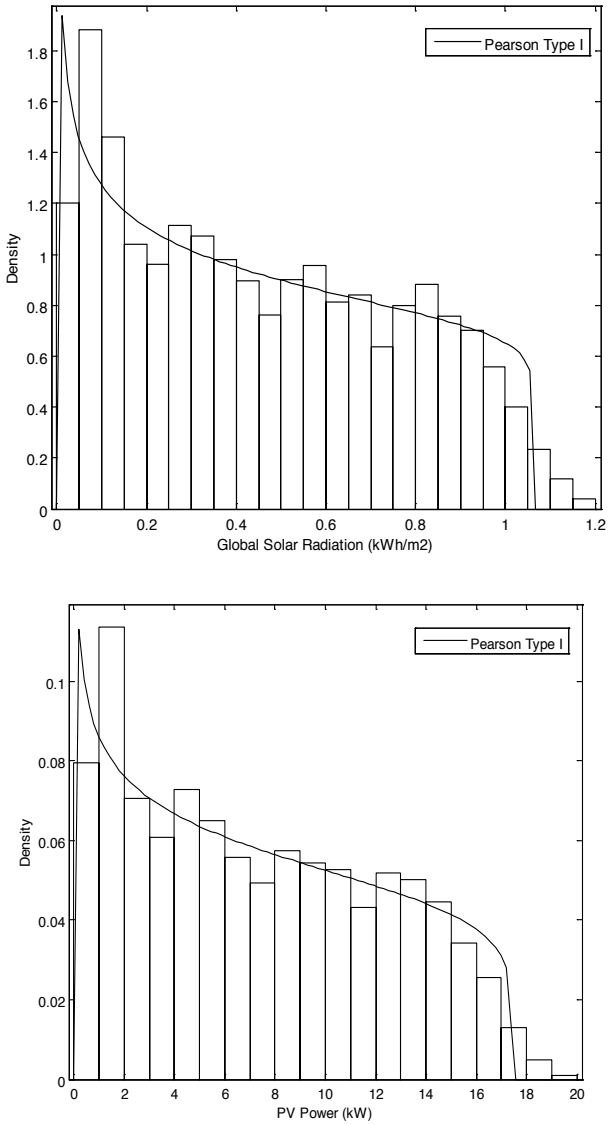

Figure 2: Frequency curves of the observed global solar radiation and the photovoltaic power

Figure 3 show the cumulative density function (CDF) curve of the observed data approximated by the Pearson system and the Weibull CDF obtained using the mean-variance analysis relative to empirical cumulative density function (ECDF).

Conventional modeling techniques are largely relies on the mean-variance analysis assuming a symmetric distribution. However it has been well suggested by numbers of research that the observed performance distributions are not always fully captured by the first two moments of the distribution. The Pearson's type 1 density curve is described by four parameters providing flexibility to take on a variety of different shapes. As shown in by PDF in Figure 2 the use of four statistical moments in approximating the density curve is also capable in providing accurate values of percentage points in the tails of distribution

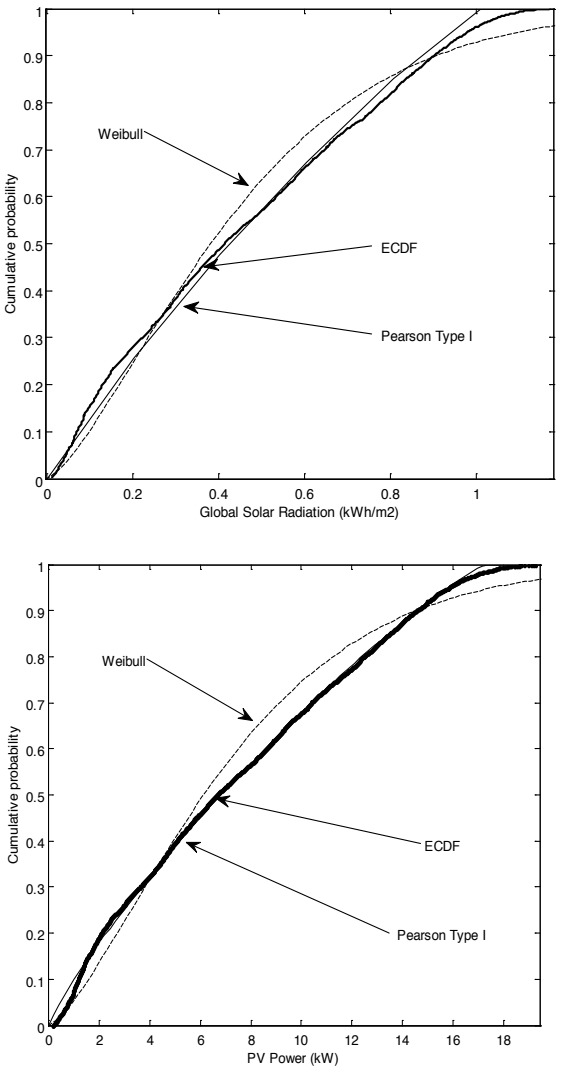

Figure 3: CDF curves of the observed data approximated by the Pearson system and the Weibull CDF

CONCLUSION

In this study the Pearson curve density function approximation was applied to acquire the suitable distribution of global solar radiation and performance of a micro gird photovoltaic stand alone system. The use of the Pearson curve in approximating the probability distribution of random variables has the advantages in terms of capability to take on variety shapes of distribution. Considering the finite range capability offered by the Pearson's type 1 frequency curve, the methodology described in this paper provides an effective means in modeling system performance characterized by acceptable limits of random input and output parameters.

ACKNOWLEDGMENTS

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E.A. Azrulhisham, K.P. Zakaria, M. Fairus Humar & W. Mustafa
1, Universiti Kuala Lumpur, Malaysia France Institute
Section 14, Jalan Teras Jernang, 43650 Bandar Baru Bangi, Selangor, Malaysia.
Email: engku@mfi.unikl.edu.my

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Kekangan Penggunaan Sistem Pembelajaran Elektronik oleh Pensyarah Kolej Poly-Tech MARA Bangi

Eirmayanti Marsam & Hazilah Mohd Amin

ABSTRAK

Sistem pembelajaran elektronik merupakan alat bantuan mengajar yang mula mewarnai dunia pendidikan terutamanya di peringkat pengajian tinggi. Sejajar dengan kemajuan perkembangan teknologi masa kini, sistem pembelajaran elektronik dilihat sebagai medium yang sangat praktikal di dalam perlaksanaan proses pengajaran dan pembelajaran. Oleh yang demikian, para pensyarah merupakan tonggak utama bagi merealisasikan keberkesanan penggunaan sistem ini. Kajian ini dijalankan bagi mengkaji kekangan terhadap penggunaan sistem pembelajaran elektronik di kalangan pensyarah Kolej Poly-Tech MARA Bangi. Persoalan kajian adalah untuk mengenal pasti kekangan yang terdiri daripada faktor usia, kemudahan prasarana teknologikal, galakan serta sifat kendiri dan cadangan penambahbaikan terhadap sistem sedia ada. Instrumen kajian yang digunakan adalah soal selidik terhadap 109 responden yang terdiri daripada pensyarah KPTM Bangi. Data diperoleh dianalisis menggunakan statistik perihalan dan statistik pentadbiran; ANOVA. Dapatan kajian mendapati pensyarah KPTM kerap mengguna Internet, mempunyai perkakasan komputer yang sempurna dan mendapat bantuan teknikal untuk menggunakan sistem pembelajaran elektronik. Namun mereka tidak berpuas hati dengan kemudahan dan kelajuan capaian internet. Kajian terhadap sifat kendiri pensyarah mendapati pensyarah di KPTM Bangi berusaha mempelajari sistem pembelajaran elektronik. Malah mereka mengakui bahawa sistem pembelajaran elektronik mudah dipelajari, mudah digunakan dan membantu mereka di dalam proses pengajaran. Walau bagaimanapun, terdapat jurang perbezaan sifat kendiri pensyarah muda dengan yang lebih berusia. Kajian ini menunjukkan pensyarah yang berada pada kategori usia 46 tahun ke atas kurang berusaha untuk mempelajari sistem pembelajaran elektronik dan kurang menghargai kepentingan sistem tersebut berbanding pensyarah yang lebih muda. Kajian ini memberi implikasi yang bermakna kepada pihak pengurusan, pengguna dan pembangun sistem pembelajaran elektronik di KPTM.

Kata kunci: sistem pembelajaran elektronik, galakan penggunaan, sifat kendiri, prasarana teknologikal, kekangan penggunaan, usia.

ABSTRACT

E-Learning system is a technology aid that is starting to grace the education world, especially at higher education. In line with today's technological advancement, e-Learning system is seen as a practical medium in the implementation of teaching and learning process. Thus, lecturers are the key element in realizing the effectiveness of this system. This study is conducted to ascertain the hindrance towards the usage of e-Learning system among lecturers of KPTM Bangi. The motion of this research is to identify the hindrance in term of factor of age, technological infrastructure, encouragement as well as self-disposition and improvement suggestion towards the available system. Research instrument used is questionnaire distributed to 109 lecturers in KPTM Bangi. Gathered data was analyzed using descriptive statistics and

inferential statistics; ANOVA. Research finding shows that KPTM's lecturers frequently uses internet, has imperforate computer hardware and receives technical assistance in using the e-Learning system. However, these respondents self-disposition are not satisfied with the facility and the internet speed. Survey's in respondents' self-disposition reveals that KPTM Bangi's lecturer endeavor to learn the e-Learning system. In fact respondents admitted that the e-Learning system is easy to grasp, user-friendly, and helps them in the teaching process. However, there is a difference gap in self-disposition between young lecturers and the aged ones. This study demonstrates that lecturers that falls under the age category of 46 and above administer less effort to learn the e-Learning system and appreciate less the importance of the system in oppose to younger lecturers. This study provides useful implication to the administration, the user, and the development of e-Learning system in KPTM Bangi.

Keywords: *e-Learning; encouragement; self-disposition; technological infrastructure; barriers in usage of e-Learning; age*

PENGENALAN

Penggunaan sistem makumat dan ICT memainkan peranan penting terhadap cara kerja masa kini. Pembangunan dan perkembangan dalam teknologi maklumat telah mengubah persekitaran perniagaan (Ward 1987). Perubahan ini turut memberi sumbangan kepada penggunaan dan perlaksanaan sistem pembelajaran elektronik terutamanya di institusi pengajian tinggi. Sistem pembelajaran elektronik merupakan sistem yang diaplikasikan untuk meningkatkan kecekapan dalam proses Pengajaran dan Pembelajaran (P&P) serta pengurusan dan pentadbiran dalam sesebuah institusi pendidikan. Para pensyarah perlu menggunakan teknologi agar mampu menyokong pengajaran dan membolehkan pelajar menggunakan teknologi sebagai alat yang penting untuk mendapatkan informasi dan keperluan pembelajaran. Melalui sistem pembelajaran elektronik pensyarah boleh berkomunikasi dengan pelajar dengan mengadakan perbincangan secara dalam talian, muat naik nota kuliah, mengemas kini kedatangan pelajar dan membuat pengumuman kepada pelajar. Para pelajar juga boleh memberi maklum balas terhadap pengajaran pensyarah, memuat turun nota kuliah, berinteraksi sesama mereka dan pensyarah serta pelbagai faedah lain.

PENYATAAN MASALAH

Perubahan peranan dalam P&P tidak dapat dielakkan dengan pengenalan teknologi multimedia dalam bidang pendidikan. Maklumat bertukar dalam mod digital dan berkembang membentuk satu suasana P&P yang menarik untuk pelajar dan pensyarah. Oleh yang demikian penyelidik ingin mengenal pasti kategori usia yang menghadapi masalah mengguna sistem pembelajaran elektronik (OLES) di KPTM Bangi. Di samping itu, faktor-faktor lain yang mempengaruhi penggunaan sistem pembelajaran elektronik juga dikaji.

Sistem pembelajaran elektronik di KPTM telah diguna pakai sejak tahun 2010. Namun begitu, terdapat permasalahan yang dihadapi oleh pengguna dalam mengakses kemudahan ini. Mohd Sukri Saud (2007) mendapati antara halangan penggunaan sistem pembelajaran elektronik adalah halangan dari segi teknologikal seperti kemudahan internet yang ada di pejabat tidak begitu memuaskan, dan juga halangan personaliti iaitu sikap pengguna itu sendiri yang lebih cenderung kepada membuka laman yang bukan sistem pembelajaran elektronik. Banyak kajian

di negara barat mencadangkan apabila sesuatu teknologi baru diperkenalkan ke dalam sesebuah organisasi, kajian seharusnya dijalankan untuk mengetahui apakah manfaat yang diperolehi oleh organisasi itu.

OBJEKTIF KAJIAN

Kajian ini adalah untuk :

i. Mengenal pasti kategori usia yang menghadapi masalah menggunakan sistem pembelajaran elektronik (OLES)
ii. Mengenal pasti faktor-faktor yang mempengaruhi penggunaan sistem pembelajaran elektronik (OLES)
iii. Mencadangkan penambahbaikan bagi mengatasi masalah yang dihadapi oleh penguna sistem pembelajaran elektronik (OLES)

KEPENTINGAN KAJIAN

Sistem pembelajaran elektronik diyakini memberi banyak faedah dan kemudahan kepada penggunanya. Para pensyarah dapat memantau penglibatan pelajar, pelajar dapat berhubung dengan pensyarah bukan hanya ketika waktu kuliah, dan proses P&P menjadi lebih mudah dengan adanya sistem ini.

Melalui dapatan kajian ini pihak pengurusan sistem pembelajaran elektronik dapat mengetahui tahap kepuasan pengguna dalam menggunakan sistem ini. Dengan mengetahui tahap kejayaan dan masalah yang dihadapi pengguna, pihak pengurusan boleh melakukan penambahbaikan dalam sistem tersebut untuk kepentingan bersama. Sekiranya kajian seterusnya dijalankan terhadap sistem, cadangan oleh kajian ini boleh dipertimbangkan untuk memperbaiki dan memperkembangkan lagi sistem pembelajaran elektronik yang digunakan.

METOD

Kajian tinjauan melalui soal selidik digunakan untuk mendapatkan maklumat tentang responden dari segi umur, jantina, jabatan dan kekerapan menggunakan sistem pembelajaran elektronik. Selain itu maklumat tentang permasalahan yang dihadapi oleh pengguna sistem pembelajaran elektronik untuk mengakses kemudahan ini juga diambil kira di samping cadangan penambahbaikan yang diberi oleh responden.

Populasi kajian ini adalah seramai 114 orang pensyarah KPTM Bangi. Seramai 109 (96%) orang responden daripada pensyarah di KPTM Bangi dipilih secara rawak telah menjawab soal selidik pada Mac hingga April 2013.

Instrumen kajian soal selidik yang digunakan mengandungi dua bahagian iaitu Bahagian A Demografi, Bahagian B(I) Kemudahan Prasarana Teknologikal, Bahagian B(II) Galakan Penggunaan Sistem Pembelajaran Elektronik, Bahagian B (III) Sifat Kendiri. Soalan dalam Bahagian B mengguna pakai Skala Likert 1 (sangat tidak setuju) hingga 5 (sangat setuju) untuk mengukur darjah persetujuan dan pandangan responden terhadap sesuatu pernyataan.

Kajian rintis telah dijalankan terhadap responden di KPTM Bangi. Ujian kebolehpercayaan dijalankan dengan menggunakan Program SPSS dan nilai Cronbach's Alpha yang diperolehi ialah 0.884. Nilai Cronbach's Alpha dapat menunjukkan item-item dalam soal selidik mempunyai kesahan dan kebolehpercayaan yang tinggi dan boleh digunakan. Menurut Nunnally & Bernstein (1994), nilai Cronbach's Alpha melebihi 0.6 menunjukkan nilai kebolehpercayaan yang tinggi dan boleh digunakan untuk kajian sebenar. Nilai kebolehpercayaan kajian ini (0.884) menunjukkan soalan soal selidik dianggap bagus dan boleh digunakan.

DAPATAN KAJIAN

Data dianalisis secara deskriptif dan inferensi menggunakan ANOVA. ANOVA digunakan untuk membandingkan min sifat kendiri antara pensyarah berdasarkan usia (Bahagian 6.2). Analisis deskriptif secara peratusan dijalankan untuk menganalisis demografi responden (Bahagian 6.1) dan keperluan pensyarah (Bahagian 6.4). Manakala, analisis deskriptif min dijalankan untuk mendapatkan tahap kemudahan prasarana teknologikal (Bahagian 6.3), tahap galakan penggunaan sistem pembelajaran elektronik (Bahagian 6.4), dan tahap sifat kendiri responden (Bahagian 6.5). Hasil kajian ini telah berjaya mengenal pasti dan memenuhi objektif dan seterusnya mencapai matlamat kajian yang dikemukakan.

Demografi Responden

Kategori umur responden paling ramai berada dalam lingkungan 20-35 tahun. Iaitu seramai 47 orang (43.1%). Diikuti dengan 32 orang (29.4%) bagi pensyarah yang berusia 36-45 tahun dan 30 orang yang berusia 46 tahun keatas (27.5%). Ini menunjukkan bahawa KPTM Bangi dimonopoli oleh para pensyarah muda. Responden yang terlibat dalam kajian adalah terdiri dari 12 orang pensyarah lelaki (11.0%) dan 97 orang pensyarah perempuan (89.0%). Majoriti responden yang menjawab soal selidik adalah bangsa Bumiputera ataupun Melayu dengan 103 (94.5%) orang daripada jumlah keseluruhan responden. Bangsa India adalah seramai 6 orang sahaja iaitu 5.5%. Tiada responden berbangsa Cina atau bangsa lain yang terlibat sebagai responden soal selidik ini. Peratusan responden terbanyak adalah daripada Jabatan Pengurusan Perniagaan iaitu seramai 26 orang (23.9%). Diikuiti oleh Jabatan Matematik dan Sains Komputer seramai 24 orang (22.0%) dan Jabatan Perakaunan seramai 23 orang (21.1%). Seterusnya Jabatan Bahasa seramai 19 orang (17.4%). Jumlah responden paling sedikit adalah dari Jabatan Pengajian Umum seramai 17 orang iaitu menyumbang sebanyak 15.6% dari peratusan rerponden. Pendidikan tertinggi bagi responden yang terlibat di dalam menjawab soal selidik ini adalah terdiri daripada pemegang ijazah pertama iaitu seramai 64 orang (58.7%). Disusuli dengan 45 orang responden (41.3%) yang mempunyai sarjana. Ini mungkin disebabkan oleh kebanyakan kursus yang ditawarkan di KPTM Bangi adalah bagi peringkat sijil dan diploma. Taburan dan peratusan responden yang berkhidmat kurang dari setahun di KPTM Bangi adalah seramai 24 orang (22.0%). Tempoh berkhidmat selama 1 hingga 5 tahun menyumbang kepada peratusan tertinggi iaitu seramai 61 orang (56.0%). 10 orang responden (9.2%) responden telah berkhidmat selama 6 hingga 10 tahun dan seterusnya 14 orang responden (12.8%) bagi responden yang telah berkhidmat lebih dari 10 tahun di KPTM Bangi.

Seramai 84 orang (77.1%) responden mempunyai pengalaman menggunakan internet selama 11 hingga 20 tahun. Diikuti oleh 20 responden (18.3%) yang berpengalaman kurang dari 10 tahun. 3 responden (2.8%) mempunyai berpengalaman 21 hingga 30 tahun dan 2 orang responden (1.8%) mempunyai berpengalaman lebih dari 31 tahun. Ini menunjukkan bahawa secara keseluruhan responden telah mempunyai pendedahan terhadap penggunaan internet. Seterusnya, majoriti daripada responden menggunakan sistem pembelajaran elektronik kurang dari dua kali seminggu dengan jumlah seramai 68 orang (62.4%). Manakala untuk penggunaan sistem pembelajaran elektronik bagi 3 hingga 5 kali seminggu adalah seramai 34 orang responden (31.2%). Bagi kekerapan 6 hingga 10 kali pula mencatatkan hanya 2 orang responden iaitu 1.8% dan selebihnya adalah 5 orang responden (4.6%) bagi kekerapan yang menggunakan sistem pembelajaran elektronik lebih dari 10 kali seminggu.

Hasil analisis terhadap responden menggunakan sistem pembelajaran elektronik sama ada di atas kehendak sendiri ataupun tidak mencatat 66 orang (60.6%) responden bersetuju bahawa mereka menggunakan sistem pembelajaran elektronik di atas kehendak mereka sendiri dan bukan atas paksaan. Manakala 43 (39.4%) pula menyatakan bahawa mereka menggunakan sistem pembelajaran elektronik bukan di atas kehendak sendiri. Antara sebab-sebab yang menyebabkan mereka menggunakannya adalah atas desakan pihak atasan dan untuk mengeluarkan surat amaran kepada pelajar.

Perbezaan Min Sifat Kendiri Antara Pensyarah Berdasarkan Usia

Dalam menjawab persoalan kajian 1, analisis ujian ANOVA digunakan untuk meneliti perbezaan yang bererti di antara skor min sifat kendiri pensyarah 20-35 tahun, 36-45 tahun dan 46 tahun ke atas. Ujian ANOVA menunjukkan bahawa terdapat perbezaan signifikan skor min sifat kendiri pensyarah di KPTM antara pensyarah berlainan usia untuk setiap pernyataan dalam subkonstruk sifat kendiri seperti berikut:

Bagi penyataan 'OLES membantu saya dalam proses pengajaran' [F(2,106)=4.622, p=0.012] ujian *post hoc Scheffe* menunjukkan terdapat perbezaan signifikan tahap OLES membantu pensyarah 46 tahun ke atas (min=3.50 s.d.=0.572) berbanding pensyarah 20-35 tahun (min=3.94, s.d.=0.673); [p=0.019]. Skor min pensyarah 20-35 tahun (min=3.94, s.d.=0.673) dan 36-45 tahun (min=3.91, s.d.=0.689) adalah lebih tinggi berbanding pensyarah 46 tahun ke atas (min=3.50 s.d.=0.572). Ini membuktikan bahawa mereka yang telah berusia menganggap OLES kurang membantu dalam proses P&P berbanding pensyarah yang lebih muda.

Bagi penyataan 'OLES sesuai dengan kursus yang saya ajar' [F(2, 106)=3.590, p=0.031] ujian *post hoc Scheffe* menunjukkan terdapat perbezaan signifikan tahap kesesuaian OLES dengan kursus pensyarah 46 tahun ke atas berbanding pensyarah 20-35 tahun [p=0.032]. Skor min pensyarah 20-35 tahun (min=3.85, s.d.=0.751) dan 36-45 tahun (min=3.72, s.d.=0.772) adalah lebih tinggi berbanding pensyarah 46 tahun ke atas (min=3.40 s.d.=0.621). Ini membuktikan bahawa mereka yang telah berusia menganggap OLES kurang sesuai dengan kursus berbanding pensyarah yang lebih muda.

Bagi penyataan 'Saya berusaha mempelajari OLES' [F(2,106)=6.077, p=0.003] ujian *post hoc Scheffe* menunjukkan terdapat perbezaan signifikan tahap usaha pensyarah 46 tahun ke atas (min=3.43, s.d.=0.626) berbanding pensyarah 20-35 tahun (min=3.94, s.d.=0.704); [p=0.008].

Terdapat juga perbezaan signifikan tahap usaha pensyarah 46 tahun ke atas (min=3.43, s.d.=0.626) berbanding pensyarah 36-45 tahun (min=3.94, s.d.=0.669); [p=0.015]. Namun demikian, tidak terdapat perbezaan signifikan tahap usaha pensyarah 20-35 tahun (min=3.94, s.d.=0.704) berbanding pensyarah 36-45 tahun (min=3.94, s.d.=0.669); [p=1.000]. Min paling rendah untuk pensyarah 46 tahun ke atas membuktikan bahawa mereka yang telah berusia kurang berusaha untuk mempelajari OLES.

Bagi penyataan 'Saya sentiasa bertanya mengenai OLES' [F(2, 106)=7.771, p=0.001] ujian *post hoc Scheffe* menunjukkan terdapat perbezaan signifikan tahap ingin tahu pensyarah 46 tahun ke atas (min=3.43 s.d.=0.626) mengenai OLES berbanding pensyarah 20-35 tahun (min=4.06, s.d.=0.763); [p=0.001]. Begitu juga, terdapat perbezaan signifikan tahap ingin tahu pensyarah 46 tahun ke atas (min=3.43 s.d.=0.626) mengenai OLES berbanding pensyarah 36-45 tahun (min=3.97, s.d.=0.695); [p=0.014]. Namun begitu, tidak terdapat perbezaan signifikan tahap ingin tahu pensyarah 20-35 tahun (min=4.06, s.d.=0.763) mengenai OLES berbanding pensyarah 36-45 tahun (min=3.97, s.d.=0.695); [p=0.843]. Min paling rendah untuk pensyarah 46 tahun ke atas membuktikan bahawa mereka yang telah berusia kurang bertanya mengenai OLES.

Bagi penyataan 'OLES mudah dipelajari' [F(2, 106)=5.786, p=0.004] ujian *post hoc Scheffe* menunjukkan terdapat perbezaan signifikan skor min pensyarah 46 tahun ke atas berbanding pensyarah 20-35 tahun [p=0.007]. Kategori usia 46 tahun ke atas dan 36-45 tahun juga menunjukkan perbezaan signifikan [p=0.030]. Skor min pensyarah 20-35 tahun (min=3.96, s.d.=0.779) dan 36-45 tahun tahun (min=3.91, s.d.=0.777) adalah lebih tinggi berbanding pensyarah 46 tahun ke atas (min=3.40 s.d.=0.621). Ini membuktikan bahawa mereka yang lebih muda menganggap OLES lebih mudah dipelajari berbanding pensyarah yang telah berusia.

Bagi penyataan 'OLES mudah digunakan' [F(2, 106)=5.026, p=0.008] ujian *post hoc Scheffe* menunjukkan terdapat perbezaan signifikan tahap OLES mudah digunakan pensyarah 46 tahun ke atas berbanding pensyarah 20-35 tahun [p=0.013]. Skor min pensyarah 20-35 tahun (min=3.89, s.d.=0.729) dan 36-45 tahun (min=3.84, s.d.=0.723) adalah lebih tinggi berbanding pensyarah 46 tahun ke atas (min=3.40 s.d.=0.621). Ini membuktikan bahawa mereka yang muda menganggap OLES lebih mudah digunakan berbanding pensyarah yang telah berusia.

Bagi penyataan 'Saya berpuas hati dengan OLES' [F(2, 106)=4.678, p=0.011] ujian *post hoc Scheffe* menunjukkan terdapat perbezaan signifikan tahap kepuasan terhadap OLES pensyarah 46 tahun ke atas berbanding pensyarah 20-35 tahun [p=0.023]. Kategori usia 46 tahun ke atas dan 36-45 tahun juga menunjukkan perbezaan signifikan [p=0.038]. Skor min pensyarah 20-35 tahun (min=3.74, s.d.=0.765) dan 36-45 tahun tahun (min=3.75, s.d.=0.762) adalah lebih tinggi berbanding pensyarah 46 tahun ke atas (min=3.27 s.d.=0.640). Ini membuktikan bahawa mereka yang muda lebih berpuas hati dengan OLES berbanding pensyarah yang telah berusia.

Sebagai kesimpulan, kajian ini mendapati pensyarah yang telah berusia menganggap OLES kurang membantu dalam proses P&P dan kurang sesuai dengan kursus yang diajar berbanding pensyarah yang lebih muda. Anggapan ini menyebabkan pensyarah yang telah berusia kurang berusaha dan kurang bertanya untuk mempelajari OLES. Disebabkan oleh kurangnya usaha, mereka mengalami kesukaran untuk mempelajari dan menggunakan OLES berbanding pensyarah yang lebih muda. Kesukaran yang dialami menyebabkan mereka berasa kurang berpuas hati dengan OLES berbanding pensyarah muda. Dapatan kajian ini sebenarnya sejajar dengan pendapat yang dikemukakan oleh beberapa orang pengkaji terdahulu. Kajian Ng et al. (2005) berkaitan jangkaan terhadap proses pembelajaran terarah kendiri mendapati bahawa

terdapat perhubungan yang tinggi antara kesedaran pembelajaran dengan penggunaan kaedah pembelajaran kendiri dengan menggunakan teknologi maklumat. Beliau mendapati pensyarah yang berada pada kategori usia 46 tahun ke atas menghadapi masalah untuk menggunakan sistem pembelajaran elektronik dan sifat kendiri memberi kesan terhadap pengaplikasian sistem tersebut.

Tahap Kemudahan Prasarana Teknologikal

Berdasarkan Jadual 1, dapatan menunjukkan min keseluruhan ialah 3.27. Nilai min yang terendah adalah bagi penyataan 'Saya berpuas hati dengan kemudahan capaian internet' dan penyataan 'Saya berpuas hati dengan keajuan capaian internet' iaitu 2.35 masing-masing. Ini menunjukkan bahawa kemudahan internet dan keajuan capaian internet di KPTM berada pada tahap yang tidak memuaskan.

Penyataan 'Saya kerap menggunakan internet' dan penyataan 'Saya mempunyai perkakasan komputer/laptop yang sempurna' mencatat min tertinggi iaitu 4.47 dan 3.85 yang menerangkan bahawa pensyarah kerap mengakses internet dan mempunyai perkakasan komputer yang sempurna.

Jadual 1: Analisis Penyataan Kemudahan Prasarana Teknologikal Di KPTM Bangi

Bil	Penyataan	Peratusan dan Kekerapan					Min
		STS f %	TS f %	TP f %	S f %	SS f %	
1.	Saya kerap menggunakan Internet	0 0	1 0.9	5 4.6	45 41.3	58 53.2	4.47
2.	Saya mempunyai perkakasan komputer/ laptop yang sempurna	5 4.6	2 1.8	26 23.9	47 43.1	29 26.6	3.85
3	Saya berpuas hati dengan kemudahan capaian internet	27 24.8	31 28.4	37 33.9	14 12.8	0 0	2.35
4.	Saya berpuas hati dengan kelajuan capaian internet	25 22.9	30 27.5	45 41.3	9 8.3	0 0	2.35
5.	Makmal pensyarah yang disediakan sentiasa terbuka untuk kegunaan pensyarah	4 3.7	12 11.0	36 33.0	48 44.0	9 8.3	3.42
6.	Perisian Pembelajaran Elektronik (OLES) adalah terkini	2 1.8	22 20.2	46 42.2	34 31.2	5 4.6	3.17
	Min						**3.27**

Tahap Galakan Penggunaan Sistem Pembelajaran Elektronik

Jadual 2 menunjukkan bahawa penyataan 'Saya mendapat bantuan teknikal untuk guna OLES' memberikan nilai min sebanyak 3.41. Ini menunjukkan bahawa pensyarah ada mendapat bantuan teknikal di dalam menggunakan sistem pembelajaran elektronik. Di KPTM, terdapat kumpulan pensyarah yang telah dilantik khas bagi membantu para pensyarah yang mengalami sebarang kesulitan ketika menggunakan sistem pembelajaran elektronik. Kajian terhadap keperluan pensyarah mendapati 62.4% responden masih memerlukan bantuan teknikal. Justeru itu, bantuan teknikal yang telah disediakan oleh KPTM perlu diteruskan atau dipertingkatkan lagi.

Min bagi penyataan 'Semua pensyarah wajib guna OLES' pula adalah 3.62. Manakala, penyataan 'Tindakan akan dikenakan kpd pensyarah yang tidak menggunakan OLES' memberikan nilai min 2.96. Nilai min ini menunjukkan pensyarah bersetuju untuk diwajibkan penggunaan sistem pembelajaran elektronik tetapi tidak bersetuju tindakan dikenakan kepada pensyarah yang engkar. Kajian terhadap keperluan pensyarah mendapati hanya 28.4% responden memerlukan penguatkuasaan dalam penggunaan sistem pembelajaran elektronik.

Penyataan 'Saya mendapat latihan secukupnya untuk OLES' memberikan nilai min 3.03. Nilai min yang rendah ini menunjukkan pensyarah masih tidak mendapat latihan secukupnya. Kajian terhadap keperluan pensyarah mendapati 45% responden memerlukan latihan/seminar kemahiran pembelajaran elektronik. Kajian ini juga mendapati majoriti pensyarah (82.6%) tidak memerlukan insentif/ganjaran untuk menggunakan sistem pembelajaran elektronik.

Jadual 2: Analisis Setiap Penyataan Galakan Penggunaan Sistem Pembelajaran Elektronik

Bil	Penyataan	Peratusan dan Kekerapan					Min
		STS f %	TS f %	TP f %	S f %	SS f %	
1.	Saya mendapat bantuan teknikal untuk menggunakan Pembelajaran Elektronik (OLES)	4 3.7	10 9.2	41 37.6	45 41.3	9 8.3	3.41
2.	Saya mempunyai manual Pembelajaran Elektronik (OLES)	3 2.8	6 5.5	28 25.7	55 50.5	17 15.6	3.71
3	Pembelajaran elektronik (OLES) penting untuk P&P saya	2 1.8	14 12.8	52 47.7	31 28.4	10 9.2	3.30
4.	Saya mendapat latihan yang secukupnya berkaitan Pembelajaran Elektronik (OLES)	2 1.8	29 26.6	47 43.1	26 23.9	5 4.6	3.03
5.	Semua pensyarah wajib menggunakan Pembelajaran Elektronik (OLES)	2 1.8	10 9.2	42 38.5	28 25.7	27 24.8	3.62
6.	Tindakan akan dikenakan kepada pensyarah yang tidak pernah menggunakan Pembelajaran Elektronik (OLES)	20 18.3	15 13.8	38 34.9	21 19.3	15 13.8	2.96
	PURATA						**3.34**

Tahap Sifat Kendiri Pensyarah KPTM

Jadual 3 menunjukkan min bagi setiap penyataan sifat kendiri pensyarah terhadap sistem pembelajaran elektronik. Min purata perolehan ialah 3.70.

Penyataan 'Saya sentiasa bertanya mengenai OLES' mencatatkan nilai min tertinggi iaitu sebanyak 3.86. Hal ini menunjukkan responden sentiasa bertanya mengenai sistem pembelajaran elektronik sekiranya berlaku sebarang kesulitan semasa menggunakannya. Bagi penyataan 'Saya berusaha mempelajari OLES, 'OLES membantu saya dlm proses pengajaran' dan 'OLES mudah dipelajari, nilai min yang diperolehi adalah 3.80, 3.81 dan 3.79. Nilai min ini menunjukkan pensyarah berusaha mempelajari sistem pembelajaran elektronik, pensyarah mengaku sistem pembelajaran elektronik membantu di dalam proses P&P dan mengakui sistem pembelajaran elektronik mudah dipelajari. Bagi penyataan 'OLES sesuai dengan kursus yang saya ajar', 'OLES

mudah digunakan' dan 'Saya berpuas hati dengan OLES', masing-masing mencatat nilai min 3.69, 3.74 dan 3.61. Nilai min ini menunjukkan sistem tersebut sesuai dengan kursus yang diajar, mudah dipelajari dan pensyarah berpuas hati terhadap sistem tersebut. Min terendah ialah 3.36 iaitu bagi penyataan 'Sistem pembelajaran elektronik penting bagi KPI pensyarah'.

Jadual 3: Analisis Setiap Penyataan Sifat Kendiri

Bil	Penyataan	Peratusan dan Kekerapan					Min
		STS f %	TS f %	TP f %	S f %	SS f %	
1.	Saya berusaha mempelajari penggunaan Pembelajaran Elektronik (OLES)	0 0	3 2.8	31 28.4	60 55.0	15 13.8	3.80
2.	OLES membantu saya dalam proses pengajaran	0 0	1 0.9	34 31.2	59 54.1	15 13.8	3.81
3.	Saya sentiasa bertanya sekiranya menghadapi masalah ketika menggunakan Pembelajaran Elektronik (OLES)	0 0	3 2.8	30 27.5	55 50.5	21 19.3	3.86
4.	Pembelajaran Elektronik (OLES) mudah dipelajari	0 0	3 2.8	37 33.9	49 45.0	20 18.3	3.79
5.	Pembelajaran Elektronik (OLES) sesuai dengan kursus yang saya ajar	0 0	3 2.8	43 39.4	48 44.0	15 13.8	3.69
6.	Pembelajaran Elektronik (OLES) mudah digunakan	0 0	3 2.8	37 33.9	54 49.5	15 13.8	3.74
7.	Pembelajaran Elektronik (OLES) penting untuk KPI saya	0 0	2 1.8	71 65.1	31 28.4	5 4.6	3.36
8.	Saya berpuas hati dengan Pembelajaran Elektronik (OLES)	0 0	5 4.6	45 41.3	46 42.2	13 11.9	3.61
	PURATA						3.70

PERBINCANGAN

Analisis perbezaan min sifat kendiri di kalangan pensyarah mengikut usia mendapati pensyarah yang berada di dalam lingkungan usia 46 tahun ke atas mempunyai skor min sifat kendiri yang rendah. Ini menunjukkan bahawa usia mempengaruhi sifat kendiri para pensyarah di dalam menggunakan sistem pembelajaran elektronik.

Analisis kemudahan prasarana teknologikal mendapati responden kerap menggunakan internet dan berpuas hati terhadap perkakasan komputer yang disediakan oleh pihak KPTM. Walaubagaimanapun, mereka tidak berpuas hati dengan tahap capaian dan kelajuan internet. Dapatan kajian ini disokong oleh dapatan kajian Becker (1991) iaitu kekurangan infrastruktur merupakan salah satu daripada masalah utama yang dihadapi dalam penggunaan komputer di tempat kerja.

Analisis galakan penggunaan sistem pembelajaran elektronik mendapati terdapat beberapa galakan yang boleh diperbaiki seperti memberi latihan dan bantuan teknikal semasa menggunakan sistem pembelajaran elektronik. Di samping mengenakan tindakan kepada pensyarah yang tidak pernah menggunakan sistem pembelajaran elektronik. Dapatan kajian

ini selari dengan beberapa dapatan kajian lalu. Menurut Sherry (1995) tanpa sokongan pihak pentadbir, keberkesanan penggunaan komputer di pejabat menjadi sangat terhad. Kajian Bakhtiar (1995) juga menunjukkan kepentingan peranan ketua di peringkat sekolah untuk menjayakan apa jua program pendidikan.

RUMUSAN

Hasil daripada penganalisisan data serta perbincangan daripada dapatan kajian dengan ini dapat dirumuskan bahawa:

i. Usia pensyarah yang mengalami masalah untuk menggunakan sistem pembelajaran elektronik adalah pada usia 46 tahun ke atas. Ini dibuktikan oleh dapatan kajian yang telah dijalankan keatas 109 orang responden.
ii. Faktor yang mempengaruhi penggunaan sistem pembelajaran elektronik di kalangan pensyarah ialah kemudahan prasarana teknologikal, galakan dan sifat kendiri pensyarah itu sendiri. Di mana capaian Internet di KPTM Bangi adalah sangat kurang memuaskan. Selain itu galakan juga merupakan faktor penting yang memberi kesan terhadap tahap penggunaan sistem pembelajaran elektronik dikalangan pensyarah. Manakala sifat kendiri pensyarah juga amat penting kerana jika kemudahan internet adalah pada tahap yang optimum namun jika pilihan pensyarah lebih kepada enjin carian dan laman sosial berbanding sistem pembelajaran elektronik maka ia tidak membawa apa-apa perubahan
iii. Cadangan responden terhadap prasarana teknologikal di KPTM Bangi adalah perkhidmatan internet perlu dibaik pulih dan dipertingkatkan dari segi kawasan liputan, kelajuan dan bilangan pemancar. Selain itu, responden mencadangkan agar sistem pembelajaran elektronik dipelbagaikan fungsinya, sentiasa kemas kini dan berhubung terus dengan Sistem Maklumat Pelajar. Antara keperluan yang amat diperlukan oleh para pensyarah adalah bantuan teknikal dan seminar kemahiran sistem pembeajaran elektronik. Kenyataan ini disokong oleh kajian Mohd Yusof Othman (2007), kemahiran asas penggunaan komputer adalah sangat penting dalam memudahkan penggunaan e-pembelajaran.

PENGHARGAAN

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Eirmayanti Marsam
Hazilah Mohd Amin
Fakulti Teknologi dan Sains Maklumat
Universiti Kebangsaan Malaysia
43600 Bangi, Selangor, Malaysia.
eirma_yanti@yahoo.com, 017 3281197

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An Artificial Bee Colony Approach to Crude Oil Price Forecasting

Yuhanis Yusof, Zuriani Mustaffa & Siti Sakira Kamaruddin

ABSTRACT

This paper presents the utilization of swarm computing algorithm, namely the Artificial Bee Colony (ABC), as a forecasting tool. Existing forecasting models that utilizes meta heuristics algorithms suffers from large parameter tuning. Hence, the ABC algorithm that offers simple adaptation and less parameter tuning is explored and realized in the domain of natural resource commodity. An application of ABC is demonstrated in forecasting the daily price of crude oil as such commodity contributes in the economic growth of an organization. Experiments results showed that ABC is a better price forecasting model as compared to the Least Squares Support Vector Machine.

Keywords: swarm computing, artificial bee colony, time series forecasting

INTRODUCTION

Swarm Intelligence (SI) which is categorized as a subset of Evolutionary Computation (EC) (Karaboga, Gorkemli, Ozturk, & Karaboga, 2012) imitates the social behavior of animals or insects such as birds, ants, termites and bees. In the bee based algorithm, it is observed that many bee swarm algorithms have been proposed in literature such as Virtual Bee Algorithm (VBA) (Yang, 2005), Bee System (BS) (Lucic & Teodorovic, 2001) and also Artificial Bee Colony (ABC) (Karaboga, 2005). Among these algorithms, the ABC can be considered as the most broadly utilized algorithm in the literature (Karaboga, et al., 2012). The ABC algorithm is a simplified mathematical model of intelligent behavior of honey bees in food searching. Unlike any other meta heuristic algorithm which embodies a number of algorithmic parameters, in ABC, apart from population size and maximum iteration, it only has one additional parameter, namely limit. Interestingly, the limit parameter can be pre-defined based on population size and number of parameters of interest. Hence, ABC possessonly two tuning parameters (Karaboga, 2005; Karaboga & Akay, 2009). As compared to other optimization techniques such as Genetic Algorithm and Particle Swarm Optimization which suffer with more tuning parameters, this feature is an advantage in ABC algorithm (Civicioglu & Besdok, 2013). Moreover, with the employment of basic mathematical operations, it results to a simple algorithm and easy to be implemented (Bolaji, Khader, Al-Betar, & Awadallah, 2013). These two features are essential for the sake of easy adaptation to the problem in hand.

Due to the uniqueness and advantages of ABC, the application of this technique is noted in various scientific research (Civicioglu & Besdok, 2013). The application of ABC is not limited in

solving optimization task soley, but also can be extended to deal with forecasting issue. Such an approach is encouraging in literature, such as presented in Bahamish, Abdullah and Abdul Salam (2009) in protein tertiary prediction. Meanwhile in Kiran, Turanoglu and Ozceylan (2011), the application of ABC is used in CO_2 emission forecasting. Progressing further, in Gurbuz, Ozturk and Pardalos (2013), the application of ABC is realized in forecasting net electrical energy consumption in Turkey. Measured based on Coefficient of determination (R^2), the findings of the study indicated that the proposed technique is capable of acheiving positive results.

Based on these proofs, this study proposes the utilization of ABC algorithm in forecasting the daily price of crude oil. Crude oil price is chosen as empirical data due to its significant role not only to global economy but also is able to influence the political relationship among countries (Khazem, 2008). In literature, there are vast amount of studies devoted for crude oil price forecasting, particularly utilizing machine learning techniques such as Artificial Neural Network (ANN) (Haidar & Wolf, 2011; Kulkarni& Haidar, 2009) and Support Vector Machines (SVM) (Khashman & Nwulu, 2011).

The layout of this paper is organized as follows: An overview of ABC is given in Section 2. The proposed model is presented in Section 3, followed by the empirical results and discussion which are shown in Section 4. Finally, the conclusion is given in Section 5.

ARTIFICIAL BEE COLONY ALGORITHM

The ABC algorithm composes of three groups of bees, viz. Employed Bee (EB), Onlooker Bee (OB) and Scout Bee (SB). Each of them perform a simple task, yet results in complex behavior as a whole system. The distribution of colony members are equal, where half of the colony is comprised of EB and the other half filled by OB. The number of food sources is equal with the EB. This means a single EB corresponds to a single nectar source. The goal of the whole colony is to maximize the amount of nectar.

The work flow of artificial bee begins by discovering new food sources, which is carried out by the SB. Later, the EBs search for food around the food sourcesand the amount of nectars is calculated. Here, the amount of nectars is related to the fitness value of the solution under study. Upon completing the searching process, the EBs share the information collected with OBs which are waiting in the hive. This situation represent a multiple interation in the intelligent swarm system.The OBs need to decide which nectar source will they exploit and the decision depends on the information shared by the EBs. For that matter, OBs watch various dances performed by the EBs before doing the selection of food source position according to the probability which is proportional to the quality of that food source. The OBs also decide the source to be casted away and allocate the responsibled EB as SB. For the SBs, their task is to find the new valuable food sources randomly and will once again becomes EB.

Suppose the solution space of the problem is D-dimensional, where D is the number of parameters to be optimized. The fitness value of the randomly chosen site is formulated as follows (1) (Karaboga, 2005):

$$fit_i = \frac{1}{\left(1 + obj.Fun_i\right)} \tag{1}$$

where obj.Fun is the objective function. The size of EBs and OBs are both equal to the number of food sources denoted by SN. For each food source's position, one EB is assigned to it. A new food source is produced according to (2) (Karaboga, 2005):

$$v_{ij} = x_{ij} + \varphi_{ij}\left(x_{ij} - x_{kj}\right) \tag{2}$$

where;
i = 1,2,…, SN
j = 1,2,…,D
φ = a random generalized real number within the range [-1, 1], k = is a randomly selected index number in the colony. After producing the new solution, vit is compared to the original solution,x by applying greedy selection mechanism. If the new solution is better than previous one, the bee memorizes the new solution; otherwise she memorizes the previous solution. The OB selects a food source to exploit with the probability values related to the fitness values of the solution. This probability is calculated using (3) (Karaboga, 2005):

$$p_i = \frac{fit_i}{\sum_{j=1}^{SN} fit_j} \tag{3}$$

where fit_i is the fitnessof the solution v. SN is the number of food sources positions. Later, the OB searches a new solution in the selected food source site as defined by (2), the similar way as exploited by EB. In SB phase, if the fitness of a found food source has not been improved for a given number of trial (denoted by limit), it is abandoned, and the EB of that food source becomes a SB and makes a random search by (4) (Karaboga, 2005).

$$x_{id} = x_d^{\min} \quad \left(x_d^{\max} - x_d^{\min}\right) \tag{4}$$

where;
r = a random real number within the range [0,1]
$x_d^{\min}$ and $x_d^{\max}$ = the lower and upper borders in the dth dimension of the problems space.
Data representation of ABC algorithm is tabulated in Table 1.

Table 1: Data Representation of ABC Algorithm

Data Representation	Variable
D	Parameters to be optimized (α, β, γ, δ and ε) (See Section 4)
Food source position	Possible solution to obtain optimized value of parameters.
Quality of nectar	Fitness function, which is inverse to objective function
Objective function	Mean Absolute Percentage Error (MAPE) (See Section 3.5)

EXPERIMENT

This section presents description on the implemented methodology. This includes datapreparation, arrangement of input and output, the objective function for the data set of interestand the performance evaluation criteria.

Data Preparation

For empirical purposes, crude oil price time series data were employed which covers from December 1, 1997 to June 30, 1998, consisting of 146 trading days. The data set is available atBarchart website ("Barchart," 2012). From the dataset, the first 70% is used for training and the last 30% is reserved for testing.

Input and Output Arrangement

Data tabulated in Table 2 indicates the variables assigned to the features involved.

Table 2: Assigning Input and Output Variables

Input	Variable	Output
Daily closing price of crude oil price	*CL*	Daily spot price of crude oil from day 21 onwards (*CL21*)
Percent change in daily closing spot prices from the previous day of crude oil price	*%Chg*	
Standard deviation over the previous 5 days of trading days of crude oil price	*Stdev5*	
Standard deviation over the previous 21 days of trading days of crude oil price	*Stdev21*	

Based on the table, it can be seen that, besides the daily closing spot prices of crude oil, three other derivative inputs were also fed to the model. The daily spot price will help the model to fix to current price location while the derivative inputshelps the model in learning the underlying relationship that is constant over time (Malliaris&Malliaris, 2008).

OBJECTIVE FUNCTION OF ABC

In this study, the objective function is to minimize the error between forecast and actual value of crudeoil prices, which is denoted by (5) (see Sub Section D).

EVALUATION CRITERIA

The forecasting performance evaluation is guided by Mean Absolute Percentage Error (MAPE) and prediction accuracy which is defined as follows:

$$obj.Func = MAPE = \frac{1}{N}\left[\sum_{n=1}^{N}\left|\frac{y_n - p_n}{y_n}\right|\right] \quad (5)$$

Prediction accuracy = $100\% - (MAPE \times 100)$ (6)

Where n = 1, 2, …, N

y_n= actual values

p_n= predicted values

N =Number of test data

EMPIRICAL RESULTS AND DISCUSSIONS

Prior to experiment, the value of algorithmic parameters of ABC were defined as follows: SN = 10, limit = SN*D and MCN = 30000. The predictive performance of ABC was compared against the ones produced by CV-LSSVM and single LSSVM. The empirical results are shown in Table 3.The equation of crude oil price forecasting for ABC is modified from Hadavandi, Ghanbari, & Abbasian-Naghneh (2010) and is defined as follows:

$$CL21 = (\alpha \times CL) + (\beta \times \%Chg) + (\gamma \times Stdev5) + (\delta \times Stdev21) + \varepsilon \quad (7)$$

where the α, β, γ and δ are coefficients for CL, %Chg, Stdev5 and Stdev21 respectively while the ε is the constant coefficient. From the table, the MAPE produced by ABC is 5.5205%. which is 5.2278% different from LSSVM which ranked at second. The MAPE obtained potray the prediction accuracy achieved by both techniques, which are 94.4795% and 89.2517% respectively. Meanwhile, for CV-LSSVM, the MAPE produced was the lowest, which is 11.9497%. The actual and forecasting values for all comparison algorithms from the first 15 days of testing phase (from day 103 to 117) are tabulated in Table 4. The highlighed figures indicated that the respective approach has closer forecasting value as compared to the rest in certain days.

Table 3: Comparisons of ABC with CV-LSSVM and LSSVM ForecastingModels

	ABC	CV-LSSVM	LSSVM
α	0.8368	-	-
β	0.1155	-	-
γ	0	-	-
δ	1	-	-
ε	1	-	-
MAPE (%)	5.5205	11.9497	10.7483
Prediction Accuracy (%)	94.4795	88.0503	89.2517

Table 4: Actual vs. Forecasted Values by ABC, CV-LSSVM and LSSVM

Day	Target	ABC	CV-LSSVM	LSSVM
103	14.8500	14.5794	15.2664	15.267
104	14.8000	14.6928	15.1334	15.1299
105	15.1000	14.86808	13.9737	15.3818
106	15.1000	14.9691	15.1209	15.2444
107	14.6200	14.30763	14.403	15.2307
108	14.8000	14.22808	14.5336	15.2208
109	15.2000	14.1128	14.7666	15.1971
110	14.5400	13.96569	15.1304	15.1999
111	14.4200	13.99132	15.1016	15.2201
112	13.4900	14.05078	15.0134	15.241
113	13.4700	14.29539	15.3094	15.2087
114	12.7900	13.82208	15.4275	15.2426
115	12.7900	14.5459	15.5451	15.1347
116	11.6000	13.30118	15.5425	15.2055
117	12.3800	13.80183	15.6857	15.2036

CONCLUSIONS

This paper presented thean of ABC algorithm to forecast the crude oil prices. In this study, the problem of forecasting is converted to optimization which is evaluated based on MAPE and prediction accuracy. The empirical findings suggested that, with a modest requirement and limited data set, ABC is able to outperformed one of the machine learning prediction model, i.e LSSVM. Hence, ABC can be considered as a suitable tool for the context under study.

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Yuhanis Yusof, Zuriani Mustaffa & Siti Sakira Kamaruddin
School of Computing,
Universiti Utara Malaysia
Email: yuhanis@uum.edu.my

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Numerical Approach of Determining Reinforced Zone Sand-Geosynthetics Interaction Behavior

Ismail M.K.A & Mohamed Z.

ABSTRACT

The sand-geosynthetics interaction plays an important role to the stability of the reinforced soil system. The micro-mechanics behavior is difficult to determine and analyze by conventional pull out method. The Discrete Element Modelling (DEM) of pullout test was employed to study the interface behavior of geosynthetic reinforcement embedded in dense silica sand. The materials used were geogrid and geotextile as reinforcement with silica sand of mean size D50=1.375mm and D50=0.286mm subjected to normal pressure of 100kPa and 200kPa. The pullout test was modeled based on laboratory test with discrete particles disks represent the mean size of silica sand. Comparatively, the DEM result comprehends well with the experimental result. Further analysis showed that DEM method of analysis showed a significant micro-mechanics sheared pattern of particle disks known as shear band developed at contact surfaces induced by mobilized geosynthetic reinforcement. The shear band thickness was calculated with regards to kinematic signature of contact forces chain activity along the geosynthetics model. Besides shear band , a small pore space was also appeared at the geosynthetic's tail end. It is an indication of initial failure of the reinforced soil system.

Keywords: Pullout test, sand-geosynthetics, Discrete Element Modelling, shear band

INTRODUCTION

Sand-geosynthetics interaction behavior occurs at the contact surface between sand and geosynthetic reinforcement system. The reinforcement mechanism is caused by the interface effect at the reinforced zone Bao (2003). Interface effect refers to the interaction between geosynthetics that transfer the stress from the soil to the geosynthetics and is divided into two types which are friction and interlocking effect. The friction is induced by the relative displacement between reinforcement material and soil, while the interlocking is caused by the interaction of soil and geosynthetics. The effect of the interaction may give instability to the reinforced soil system in term of micro-mechanic behavior.

Pull Out Test is widely used in studying the behavior soil reinforced system either experimentally or numerically. Several researchers such as Yan et al. (1998), Sugimoto and Alagiyawanna (2003) and Khedkar and Mandal (2009) have used Finite Element Modeling to simulate Pull Out Test. McDowell et al. (2006) and Zhang et al. (2008) have conducted Discrete Element Method (DEM) to simulate the Pull Out Test. They found that the DEM is has advantages of more versatile because it considers the thousand disks as soil particles which is a better technique for soil behavior characterization. The DEM was also used by Wang et al. (2007) where

the strain localization has been simulated based on the laboratory direct shear test to obtain the shear band.

This paper presents DEM model of geosynthetics pullout interaction behavior using PFC2D software which was verified by experimental test. The DEM Pullout test model evaluates the pullout mechanism in a microscopic view and interaction behavior by paying attention to different densification effect linked with grain size and normal pressures.

NUMERICAL STUDY OF PULLOUT TEST

Simulation of Pull Out Test is carried out in order to determine the interaction between sand and geosynthetics at the reinforced zone in term of microscopic scale. The interaction has created a micro-mechanics behavior known as shear band. Validation of the DEM was made by carrying out experimental study by Ismail and Mohamed (2013).The details about the simulation process are discussed in section 2.1 until 2.3.

Micro-properties for DEM Model

The complete data of micro-properties for DEM model of sand particles is compiled in the Table 1, Table 2, Table 3 and Table 4.These micro-properties are important in modeling the particles disks to behave like the natural sand particles. Therefore, the micro-properties of the particles disks are taken from the physical properties of the sand samples.

Table 1: Micro-properties of sand for DEM model

Parameters for particles disks assembly	Normal contact stiffness, kN/m	Shear contact stiffness, kN/m	Density, g/m3	Internal friction angle (degree)	Initial Porosity, n	Mean size of particles disks, mm
Fine	1.89e5	1.89e5	2.61	44.7	0.21	0.286
Coarse	2.33e5	2.33e5	2.63	52.9	0.24	1.357

Table 2: Micro-properties of geosynthetics for DEM model

Geosynthetic model	Normal contact stiffness, kN/m	Shear contact stiffness, kN/m	Parallel bond normal strength, kN	Parallel bond shear strength, kN	Radius of particles disks, mm
Geotextile	2.36e5	2.36e5	110	110	2
Geogrid	2.36e5	2.36e5	21	21	2 and 4

Table 3: Interface friction factor between sand and geosynthetics

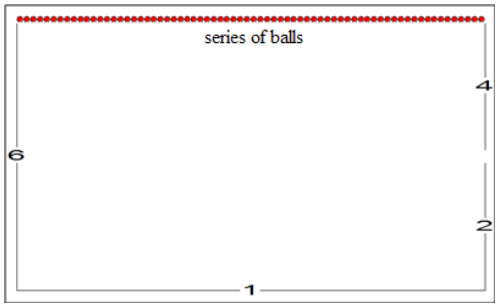
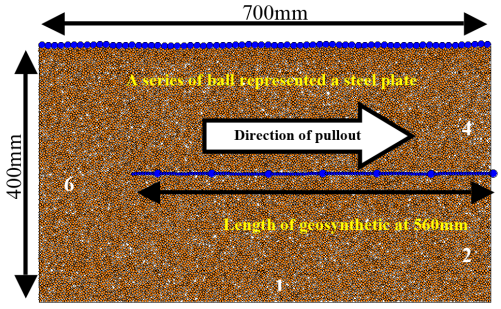
	Interface friction factor, f			
Type of sand	Coarse sand (D_{50}=1.357mm)		Fine sand(D_{50}=0.286 mm)	
Geosynthetics model	100kPa	200kPa	100kPa	200kPa
Geotextile	0.742	0.623	0.800	0.446
Geogrid	0.828	0.480	0.723	0.426

Table 4: Micro-properties of boundary condition for DEM model

Boundary identification number	Normal contact stiffness, kN/m	Shear contact stiffness, kN/m	Parallel bond normal strength, kN	Parallel bond shear strength, kN	Length, mm	Radius of particles disks, mm
1	1e10	1e10	-	-	700	-
2,4	1e10	1e10	-	-	190	-
6	1e10	1e10	-	-	400	-
Series of balls	1e10	1e10	1e14	1e14	700	5

The confined boundary created the model which represents the front view of the sand-geosynthetic pullout test. There are three types of commands were used which are 'WALL', 'BALL' and GENERATE command. Tables 5 illustrate the output for WALL, BALL and GENERATE command which constitute of Geosynthetic-Pullout Model.

Table 5: Typical Geosynthetic-Pullout Model Using WALL, BALL and GENERATE commands

INPUT	OUTPUT	
	Model	Position
WALL command		Located at X and Y axes
BALL command	1) Geosynthetics a. Geotextile b. geogrid 	In the middle of pullout model
	2) Steel plate 	Replaced the top boundary with a series of balls.
GENERATE command	3) Particles disks represent sand particles Geosynthetic-Pullout Model 	Discretely filled the boundary of Pullout Model.

Model of Geosynthetic-Pullout Test

Five boundaries were identified in making a box shape of 400mm (width) X 700mm (length). This box consists of four walls (wall id=1, 2, 4, 6) and a series of ball at the top of the model. An opening in the middle between wall id=2 and id= 4 was made to allow for the movement of geosynthetics. Thousands of particles disks were created and filled the pullout box. A series of balls was modeled as bonded particles chain that represented the embedded geosynthetic and the top wall of pull out box. The embedded geosynthetics was horizontally pullout at rate of 0.002m per timestep.

The mobilized geosynthetic has created a sheared zone and it was analyzed as the spread of contact forces chain. Two forces were acted on the particles disks, compression and tensile forces represented by Black color and Cyan color respectively. For all numerical modeling, the thickness of shear band was calculated directly with the thickness of contact forces chain at sheared zone (Rechenmacher, 2010). Figure 1 shows the typical sheared zone of sand-geosynthetic reinforced system indicated by lower part and upper part.

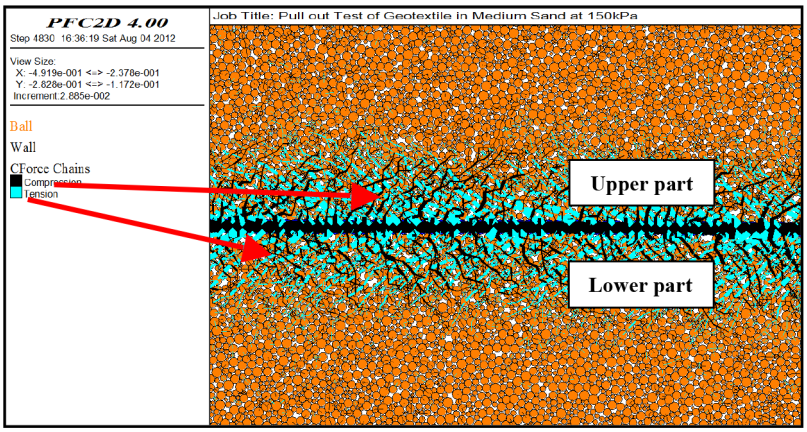


Figure 1: Typical result of Compression and Tension within Sheared Zone

RESULT AND ANALYSIS

Numerical Result of Geotextile Pullout Model

the model has experienced the peak-post failure and encouraged strain localization in the form of shear band. There is appearance of pore space at the end of the geotextile's tail which has indicated the instability of the reinforced soil system.

For coarse sand, the thickness of shear band is estimated at 108mm if the movement of geotextile achieved 22.8kN of pullout force at 100kPa of normal pressure. It has covered 27% of total height (400mm) of the pullout model. At 200kPa, the thickness of shear band is 232mm and has covered 58% of total height (400mm) of particles assemblies. Obviously, the spread of contact force chains increased if the normal pressure also increased. The increment of the thickness is caused by the particles disks which were denser after it was induced by the high pressure. This condition indirectly allowed the contact forces between particles disks increased and indirectly gained the shear strength.

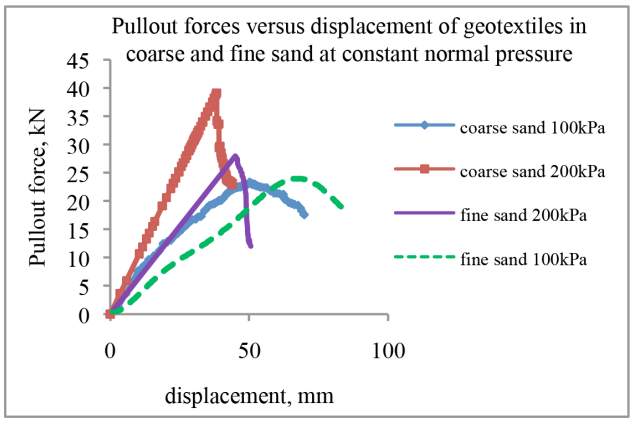
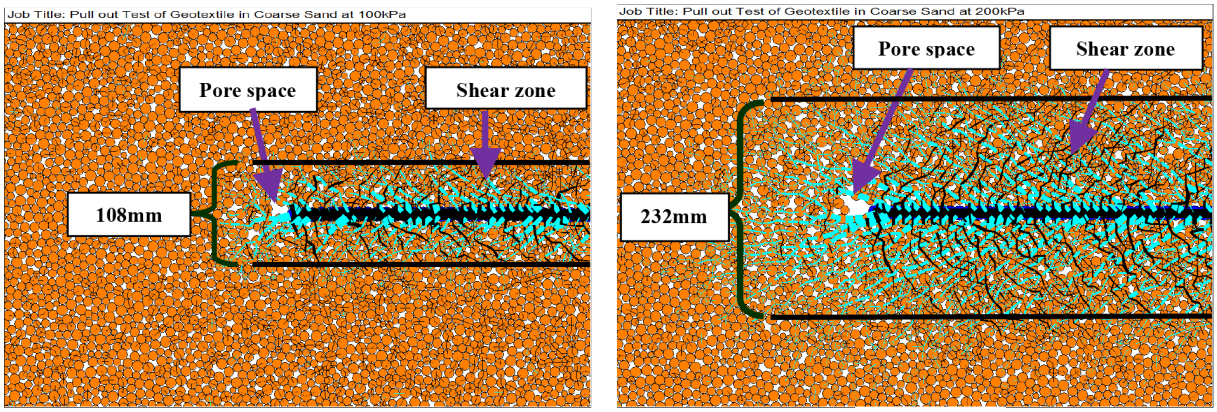


Figure 2: Pullout Force versus Displacement of Sand-Geotextile Interaction in Coarse Sand at Constant Pressure.

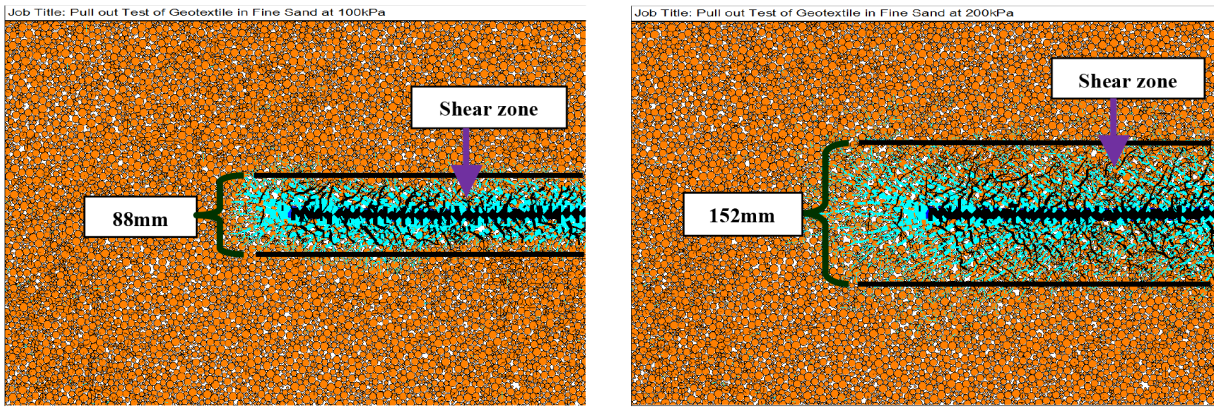


a)100kPa b)200kPa

Figure 3: Contact Force Chain Implies the Thickness of Shear Band at 108mm and 232mm

For fine sand, the geotextile has produced 88mm of sheared zone. This formation has covered 22% of total height (400mm) of pullout box. The sheared zone shows a lowest shear band thickness compared to the simulation of geotextile-pullout test in coarse sand at 100kPa. It is related to the small particles disks which provide small contact area and indirectly gave a low frictional force toward particles disks. Also, the smooth surface of geotextile has reduced the friction between particles disks and geotextile. At 100kPa, the sand particles is predicted not penetrate the geotextile surface between yarn and created a poor interface reaction. Figure 4 illustrates the shear band at 100kPa and 200kPa pressure in fine sand.

The development of the localized strain appeared around the reinforced region induced by 200kPa of normal pressure is recorded for 152mm. The thickness of shear band is 10.3% less than coarse sand and hard to be seen. However, behind this process, a narrow zone has actually appeared instantly just after the reinforcement had updated its movement. It is similar with the finding by Akira et al. (1997). A quick response is caused by the gravitational force that has been assigned to the particles in the DEM's program.



a)100kPa b)200kPa

Figure 4: Contact Force Chain Implies the Thickness of Shear Band at 88mm and 152mm

Numerical Result of Geogrid Pullout Model

Figure 5 shows the result of pullout test versus displacement for simulation of geogrid in coarse (D50=1.357mm) and fine sand (D50=0.286 mm) at 100kPa and 200kPa of normal pressure. For coarse sand, at 100kPa, the data on the graph showed gradual increase until reached the maximum pullout force at 9.96kN with respect to 52.71mm of displaced geogrid. At 200kPa of normal pressure, the maximum force is 11.58kN with respect to 52.27mm mobilized geogrid.

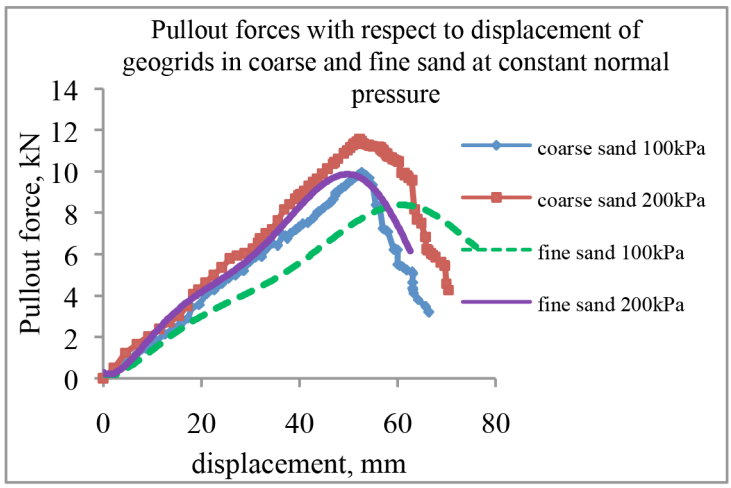


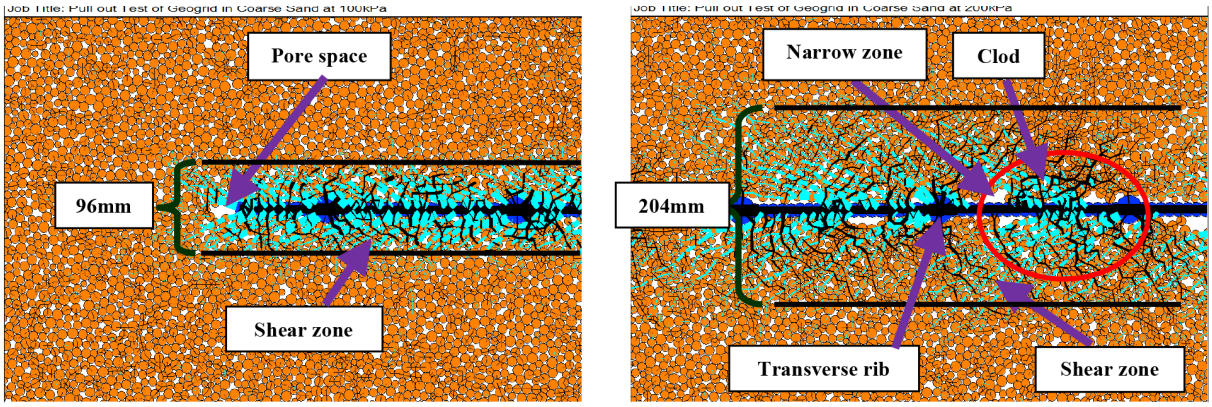
Figure 5: Pullout Force versus Displacement of Sand-Geogrid Interaction in Coarse Sand at Constant Pressure

For fine sand, at 100kPa of normal pressure, the numerical data has achieved a peak pullout force at 8.67kN with respect to 60.98mm of displacement. At 200kPa of pressure, the graph states a similar trend with 100kPa. A numerical graph shows the fluctuated pattern until it has reached a maximum pullout force at 10.23 kN with respect to 52.15mm of geogrid's displacement.

Figure 6 shows the total thickness of sheared zone induced by the movement of geogrid in coarse sand is 96mm under a constant densification at 100kPa. The embedded geogrid was moved and created a sheared zone for 204mm of thickness at 200kPa. The spread of kinematic signatures

show a non-uniform along the embedded geogrid. The tensile and compression forces seem to have a great reaction with the transverse ribs of geogrids. At certain distance, the transverse ribs are practically good in order to restraint the macroscopic failure.

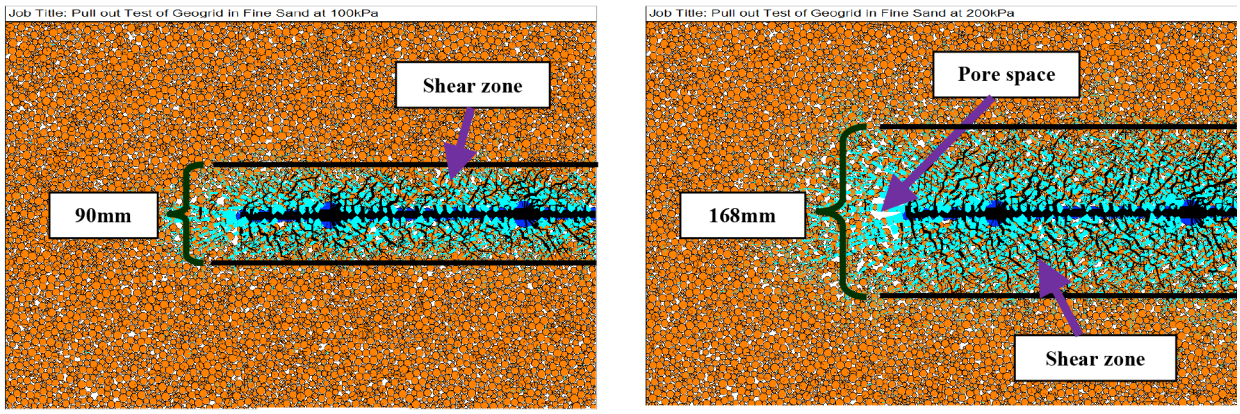
The transverse ribs start to cross over and disturbed the particles disks, indirectly gained the rotation and sliding of particles disks if the mobilized geogrid is extended. It was observed that the development of several set of clods just after transverse ribs crossed the particles disks. The effect of the clods has encouraged the formations of narrow zone at the contact surface. This narrow zone is a cumulative of sheared and rotated of sand particles that apart of total shear band. The formation of narrow zone may gives instability of the sand media.



a)100kPa b)200kPa

Figure 6: Contact force chain implies the thickness of shear band at 96mm and 204mm

The presence of sheared region in the assembled particles disks is shown in Figure 7. It is clarified that the mobilized geogrid has induced the particles disks to move simultaneously out of the box. However, the effect of the movement was not too large compared to the coarse sand at 100kPa of pressure. It only gave 90mm of the sheared region for both upper and lower parts. It was found that a presence of instability at the tail of geogrid model which appeared as pores space. The pores space tends to enlarge if the geogrid's progress moves beyond 76mm, indirectly, the particles disks which behave as soil structure may collapse.



a)100kPa b)200kPa

Figure 7: Contact force chain implies the thickness of shear band at 90mm and 168mm

At 200kPa of normal pressure the contact forces chain is obvious to be observed and it is clearly mentioned that there is local straining present at the reinforced region. However, it is not large compared to the mobilized geotextile in fine sand. The width of the sheared particles is 168mm. It has covered 42% of total height (400mm) of pullout model.

The pullout force is observed to decrease significantly beyond the peak post failure and predicted due the loose interaction of geosynthetic with particles disks. Based on two conditions of normal pressures and grain size, it was observed that, the denser particles disks, the higher friction force and the shorter displacement of geosynthetics recorded. The shear band thickness for all numerical models is compiled in the Table 6.

Table 6: Shear band thickness for different particles size and normal pressure

Sheared zone/ total thickness of shear band, mm				
Sand size	**Coarse sand (D_{50}=1.357mm)**		**Fine sand (D_{50}=0.286 mm)**	
Geosynthetics	100kPa	200kPa	100kPa	200kPa
Geotextile	108	232	88	152
Geogrid	96	204	90	168
Percentage different, %	11	12.07	2.22	9.52

Validation Analysis

Comparative study was conducted between numerical and experimental study in order to calibrate the interaction behavior of sand-geosynthetic reinforcement mechanism. The relationship of pullout force and displacement for both tests show similar pattern. Indirectly, the mechanical behavior of the model also can be said satisfied. Figure 8 shows the calibration for geotextile in coarse sand. For numerical modeling, the maximum pullout test at failure is 0.17% more than experimental result at 100kPa. The movement is 4.0% extended compared experimental data at peak point. At 200kPa of normal pressure, the trend shows a similar characteristic whereby the data points laid down in the region of the experimental result until reached the maximum pullout force. It has recorded an equal pullout force and just displaced 0.08% more compared to experimental result.

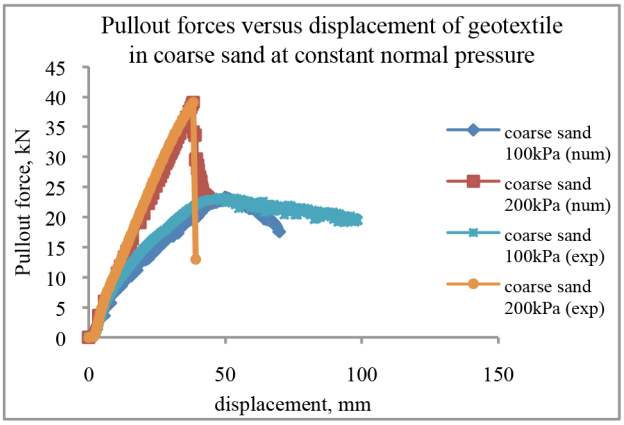


Figure 8: Calibration between numerical and experimental geogrid-pullout test in coarse sand with respect to different normal pressure

Figure 9 illustrates the validation analysis for geotextile in fine sand. At 100kPa, the peak pullout force was recorded at 24kN and has reduced to 4.3% from the experimental result at 68mm displacement of geotextile. However, at 40mm displacement, the recorded force showed a huge difference from experimental result. It has recorded 14.5kN and less about 25.6% from laboratory result at 19.5kN. For 200kPa, it has 0.21% lesser than maximum pullout force recorded by experimental result. At 10mm until 40mm of mobilized geotextile, the numerical model seems to have a parallel line with laboratory result. It is proven that both tests have similar characteristics in term of pullout rate and interaction of geotextile with particles disks at contact surface.

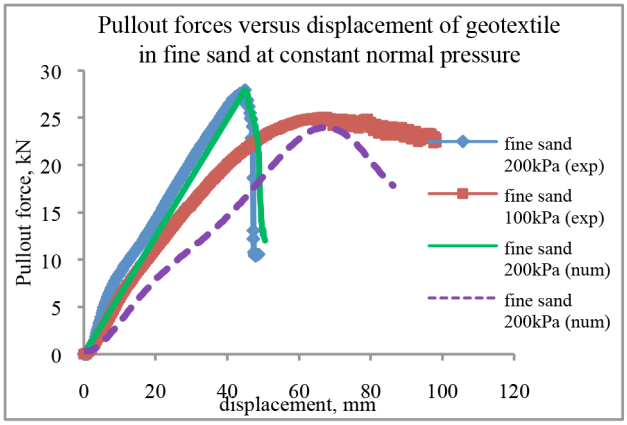


Figure 9: Calibration between numerical and experimental geotextile-pullout test in fine sand with respect to different normal pressure

Figure 10 exhibits the validation analysis for geogrid model in coarse sand. At 100kPa, the data on the graph showed gradual increase until reached the maximum pullout force. It has 0.2% higher than the maximum force recorded by laboratory result at 9.94kN.Also the displacement is 3% shorter than recorded by laboratory result at 54.37mm. At 200kPa, the numerical modeling recorded higher value of pullout forces in the beginning until end of the test. The maximum force also laid down on different extension whereby it was moved 52.27mm at 11.58kN of pullout force. The force is 0.5% higher than laboratory result. The peak-post failure showing a different trend because of the mobilized geogrid is not ruptured compared to laboratory result.

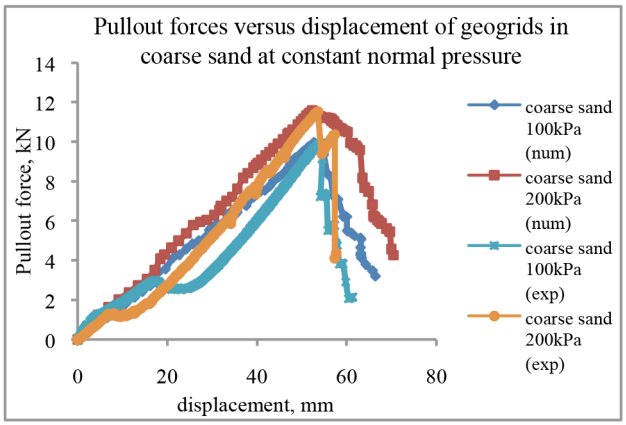


Figure 10: Calibration between numerical and experimental geogrid-pullout test in coarse sand with respect to different normal pressure

Figure 11 illustrates the comparative analysis for geogrid in fine sand. At 100kPa, the numerical model shows a similar trend with experimental at zero until 1.2kN with 8.42mm of geogrid's displacement. The numerical data has located at the same point again with experimental at 51.54mm with 7.33kN of pullout force. The behavior of numerical data is constantly in range of experimental data until model has achieved a peak pullout force at 8.67kN with respect to 60.98mm of displacement. The maximum force is equal to experimental data and the geogrid model is displaced by 0.31% more.

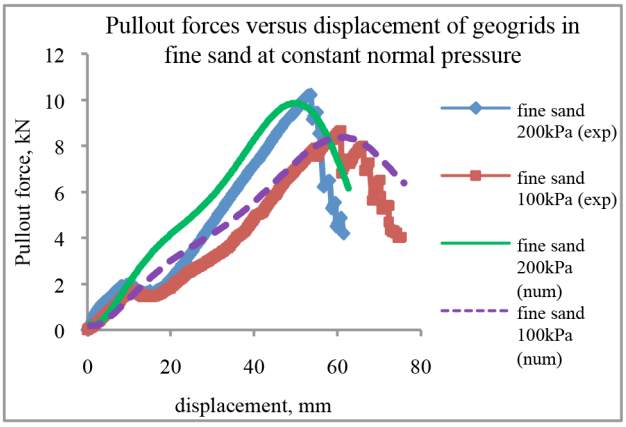


Figure 11: Calibration between numerical and experimental geogrid-pullout test in fine sand with respect to different normal pressure

At 200kPa, the graph shows different characteristic at zero and intersects with experimental result at 10.33mm with 2kN of pullout force. A numerical graph shows the fluctuated pattern until it has reached a maximum pullout force at 10.23 kN with respect to 52.15mm of geogrid's displacement. The maximum pullout test is equal with experimental result and has 2.65% difference of displacement. Overall, the experimental data gives low forces at initial because of the elongation of the geogrid due to the tensile strength. After being recovered from elongation, the true reactions of the geogrid with sand particles have increased the resistance and meet again with the numerical result at peak force.

CONCLUSION

In conclusion, the DEM model of geosynthetics-pullout test has revealed the interaction behavior between sand and geosynthetics at the contact surface in terms of micro scale. The numerical model interaction has been verified by experimental test associated with pullout forces versus displacement. The micro-mechanics failure in the form of narrow zone known as shear band is an indication of shear failure of the reinforced system. The interaction also seems to have a present of small pore spaces at the geosynthetic's tail which predicted to initiate the failure of the reinforced soil system.

Shear band phenomenon occurs silently within the kinematic signature of contact forces chain formed as sheared zone. The particles disks initial shearing is not visible because the particles simultaneously filled the narrow zones with respect to the movement of geosynthetic reinforcement. Therefore, the thickness of the shear band was evaluated in term of equivalent sheared particles disks in the sheared zone.

The grain size and normal pressure had great influence on soil reinforcement bonding during pullout test. The DEM simulation result indicated that the shear zone was thicker under higher normal pressure. The sand-geogrid interaction model in coarse sand at 200kPa has indicated slightly differ whereby there is present of several clods which induced by the disturbance of transverse ribs. The clod has gained the development of narrow zone adjacent to the interaction zone and indirectly reduced the stability of the system. This study has successfully provided greater understanding on micro-mechanics failure of the reinforced soil system indicated by the observable shear band failure profile using numerical approach.

ACKNOWLEDGEMENT

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Ismail M.K.A & Mohamed Z.
Institute for Infrastructure Engineering and Sustainable Environment,
Faculty of Civil Engineering, Universiti Teknologi MARA Malaysia.
e-mail: mkazhar_ismail@yahoo.com*, e-mail: zaina556@perak.uitm.edu.my**

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An Implementation of Full-State Observer and Controller for Dynamic State-Space Model Of Zeta Converter

Hafez Sarkawi & Mohd Hafiz Jali

ABSTRACT

Zeta converter is a fourth order dc-dc converter that can increases (step-up) or decreases (step-down) the input voltage. The converter needs feedback control to regulate its output voltage. A full-state observer can be used to estimate the states of the system in condition the output must be observable. The estimated states can be fed to full-state feedback controller to control the plant. This paper presents the dynamic model of zeta converter. The converter is modeled using state-space averaging (SSA) technique. Full-state observer and controller are implemented on the converter to regulate the output voltage. The simulation results are presented to verify the accuracy of the modeling and the steady-state performance subjected to input and load disturbances.

Keyword: Modeling, zeta converter, SSA technique, full-state feedback controller, full-state observer

ABSTRAK

Penukar Zeta adalah penukar dc-dc empat peringkat yang boleh menaik atau menurukan voltan masukan. Sesuatu penukar memerlukan pengawal suap-balik untuk mengatur voltan keluarannya. Pemantau keadaan penuh boleh digunakan unutk mengaangarkan keadaan dalam sesuatu sistem tetapi dengan syarat keluaran sistem tersebut boleh dipantau. Keadaan yang telah dianggarkan tersebut boleh disuap kepengawal suap-balik keadaan penuh untuk mengawal sesuatu loji. Kertas ini mempersembahkan model dinamik untuk penukar zeta. Penukar tersebut dimodelkan menggunakan teknik purata ruang keadaan (PRK). Pemantau dan pengawal keadaan penuh diletakkan pada penukar tersebut untuk mengatur voltan keluaran. Hasil simulasi akan dipersembahkan untuk mengesahkan ketetapan model penukar tersebut dan sambutan keadaan mantapnya apabila dimasukkan hingar pada masukan dan beban.

Kata kunci: Pemodelan, penukar zeta, teknik PRK, pengawal suap-balik keadaan penuh, pemantau keadaan penuh.

INTRODUCTION

Zeta converter is fourth order dc-dc converter that can step-up or step-down the input voltage. The converter is made up of two inductors and two capacitors. Modeling plays an important role to provide an inside view of the converter's behavior. Besides that, it provides information for the design of the compensator. The most common modeling method for the converter is state-space averaging technique (SSA). Open-loop system has some disadvantages where the output cannot

be compensated or controlled if there is variation or disturbance at the input. For the case of zeta converter, the changes in the input voltage and/or the load current will cause the converter's output voltage to deviate from desired value. This is a disadvantage because when the converter is used as power supply in electronic system, problem could be happened in such that it could harm other sensitive electronic parts that consume the power supply. To overcome this problem, a closed-loop system is required. Full-state feedback controller is one of the compensator used in closed-loop system. Compared to other compensator such as PID, full-state feedback controller is time-domain approach which makes the controller design is less complicated than PID approach which is based on frequency-domain approach. This is due to the modeling process is based on state-space matrices technique. It is sometimes impossible to measure certain variables except input and output. Full-state observer can overcome this issue because it can estimate the states of the system by using input and output measurement only.

MODELING OF ZETA CONVERTER

Overview of SSA Technique

State-space averaging (SSA) is a well-known method used in modeling switching converters [1]. To develop the state space averaged model, the equations for the rate of inductor current change along with the equations for the rate of capacitor voltage change that are used.
A state variable description of a system is written as follow:

$$x' = Ax + Bu \tag{1}$$

$$v_O = Cx + Eu \tag{2}$$

where*A* is *n x n* matrix, *B* is *n x m* matrix, *C* is *m x n* matrix and *E* is *m x m* matrix. Take note that capital letter *E* is used instead of commonly used capital letter *D*. This is because *D* is reserved to represent duty cycle ratio (commonly used in power electronics).
For a system that has a two switch topologies, the state equations can be describe as [2]:

Switch closed

$$x' = A_1x + B_1u$$

$$v_O = C_1x + E_1u$$

Switch open

$$x' = A_2x + B_2u$$

$$v_O = C_2x + E_2u$$

For switch closed at time *d*T and open for (1-*d*)T, the weighted average of the equations are:

$$x' = \left[A_1 d + A_2 (1-d)\right]x + \left[B_1 d + B_2 (1-d)\right]u \tag{3}$$

$$v_O = \left[C_1 d + C_2 (1-d)\right]x + \left[E_1 d + E_2 (1-d)\right]u \tag{4}$$

By assuming that the variables are changed around steady-state operating point (linear signal), the variables can now be written as:

$$\begin{aligned} x &= X + \tilde{x} \\ d &= D + \tilde{d} \\ u &= U + \tilde{u} \\ v_O &= V_O + \tilde{v}_O \end{aligned} \tag{5}$$

where*X*, *D*, and *U* represent steady-state values, and x˜, d˜, and ũ represent small signal values. During steady-state, the derivatives (x') and the small signal values are zeros. Equation (1) now becomes:

$$0 = AX + BU \tag{6}$$

$$X = -A^{-1}BU \tag{7}$$

while Equation (2) can be written as:

$$V_O = -CA^{-1}BU + EU$$

The matrices are weighted averages as:

$$\begin{aligned} A &= A_1 D + A_2 (1-D) \\ B &= B_1 D + B_2 (1-D) \\ C &= C_1 D + C_2 (1-D) \end{aligned} \tag{8}$$

For the small signal analysis, the derivatives of the steady-state component are zero:

$$x' = X' + \tilde{x}' = 0 + \tilde{x}' = \tilde{x}'$$

Substituting steady-state and small signal quantities in Equation (5) into Equation (3), the equation can be written as:

$$\tilde{x}' = \left[A_1 (D + \tilde{d}) + A_2 (1 - (D + \tilde{d}))\right](X + \tilde{x}) + \left[B_1 (D + \tilde{d}) + B_2 (1 - (D + \tilde{d}))\right](U + \tilde{u})$$

If the products of small signal terms $\tilde{x}\tilde{d}$ can be neglected, the equation can be written as:

$$\tilde{x}' = \left[A_1 D + A_2(1-D)\right]\tilde{x} + \left[B_1 D + B_2(1-D)\right]\tilde{u} + \left[(A_1 - A_2)X + (B_1 - B_2)U\right]\tilde{d}$$

or in simplified form,

$$\tilde{x}' = A\tilde{x} + B\tilde{u} + \left[(A_1 - A_2)X + (B_1 - B_2)U\right]\tilde{d} \tag{9}$$

Similarly, the output from Equation (4) can be written as:

$$\tilde{v}_O = \left[C_1 d + C_2(1-d)\right]\tilde{x} + \left[E_1 d + E_2(1-d)\right]\tilde{u} + \left[(C_1 - C_2)X + (E_1 - E_2)U\right]\tilde{d}$$

or in simplified form,

$$\tilde{v}_O = C\tilde{x} + E\tilde{u} + \left[(C_1 - C_2)X + (E_1 - E_2)U\right]\tilde{d} \tag{10}$$

Modeling of Zeta Converter By SSA Technique

The schematic of zeta converter is presented in Fig. 1. Basically the converter are operated in two-states; ON-state (Q turns on) and OFF-state (Q turns off). When Q is turning on (ON-state), the diode is off as shown in Fig. 2.During this state, inductor L_1 and L_2 are in charging phase. When Q is turning off (OFF-state), the diode is on as presented in Fig. 3. At this state, inductor L_1 and L_2 are in discharge phase. Energy in L_1 and L_2 are discharged to capacitor C_1 and output part, respectively. To ensure the inductor current i_{L1} and i_{L2} increases and decreases linearly on respective state, the converter must operate in Continuous Conduction Mode (CCM). CCM means the current flows in inductors remains positive for the entire ON-and-OFF states. Fig. 4 shows the waveform of i_{L1} and i_{L2} in CCM mode. To achieve this, the inductor L_1 and L_2 must be selected appropriately. According to [3], the formula for selection the inductor values are:

$$L_1 > \frac{(1-D)^2 R}{2Df}\left(1 + \frac{r_{L2}}{R} + \frac{r_{C1} D}{R(1-D)}\right)$$

$$L_2 > \frac{(1-D)R}{2f}\left(1 + \frac{r_{L2}}{R}\right)$$

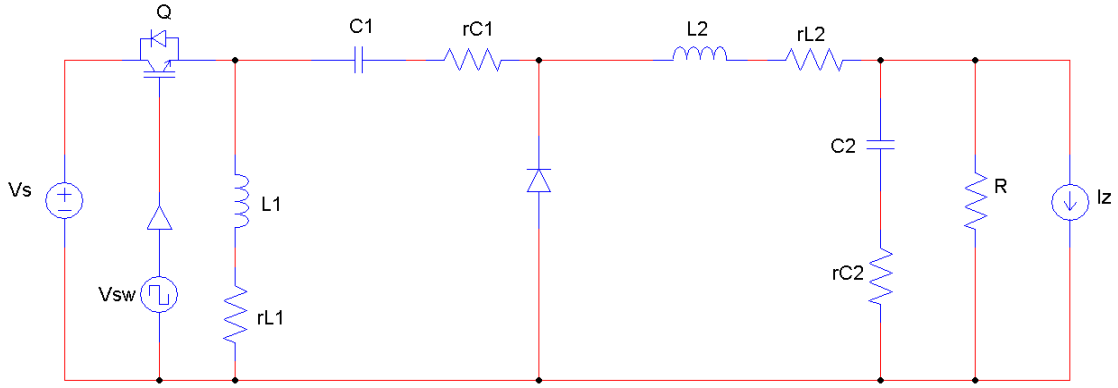

Fig. 1: Dynamic model of zeta converter

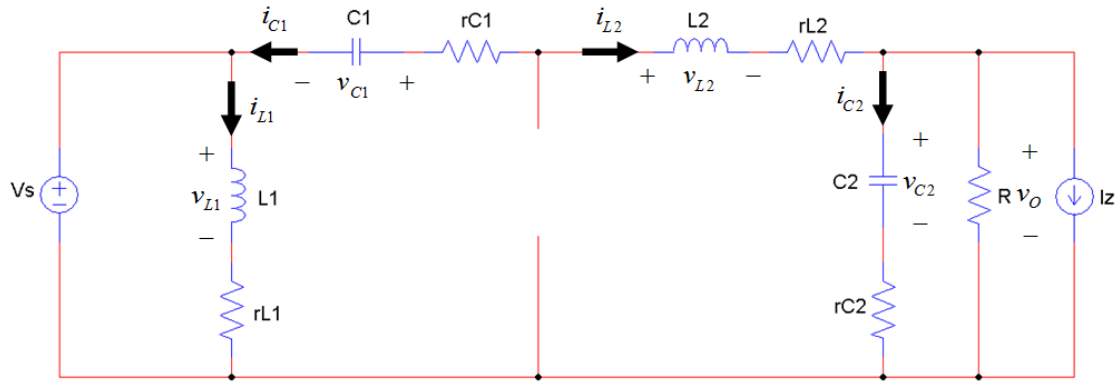

Fig. 2: Equivalent zeta converter circuit when *Q* turns on

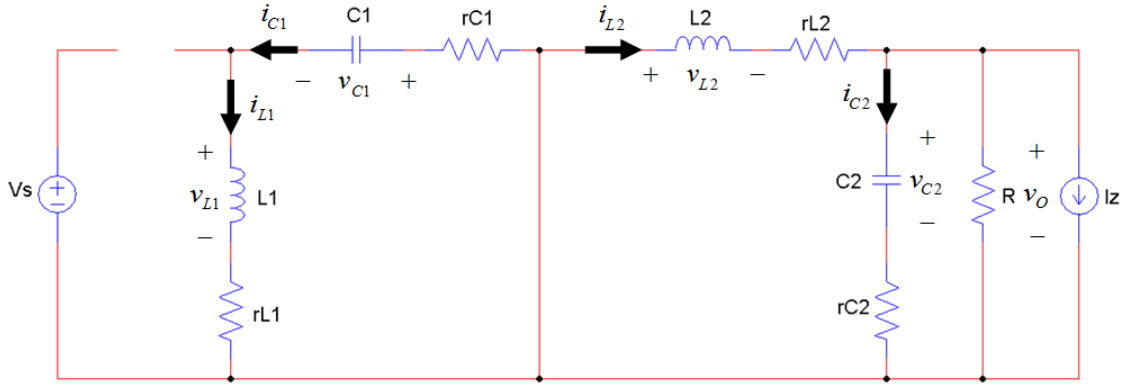

Fig. 3: Equivalent zeta converter circuit when *Q* turns off

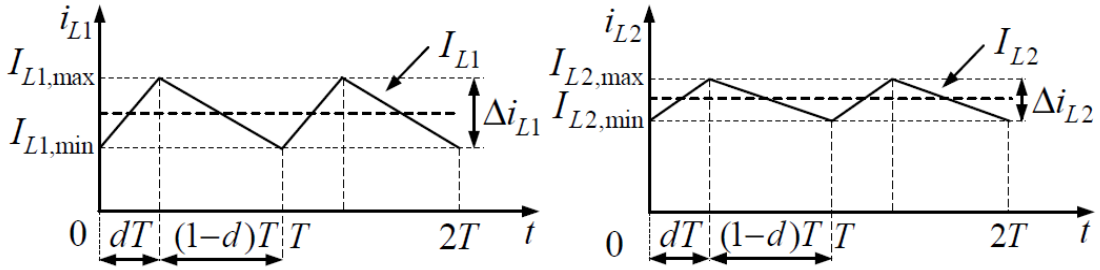

Fig. 4: i_{L1} (left) and i_{L2} (right) waveform in CCM [3]

State-space Description of Zeta Converter

ON-state (Q turns on)

$$\begin{bmatrix} \frac{di_{L1}}{dt} \\ \frac{di_{L2}}{dt} \\ \frac{dv_{C1}}{dt} \\ \frac{dv_{C2}}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{r_{L1}}{L_1} & 0 & 0 & 0 \\ 0 & -\frac{1}{L_2}\left(r_{L2}+r_{C1}+\frac{r_{C2}R}{r_{C2}+R}\right) & \frac{1}{L_2} & -\frac{R}{L_2(r_{C2}+R)} \\ 0 & -\frac{1}{C_1} & 0 & 0 \\ 0 & \frac{R}{C_2(r_{C2}+R)} & 0 & -\frac{1}{C_2(r_{C2}+R)} \end{bmatrix} \begin{bmatrix} i_{L1} \\ i_{L2} \\ v_{C1} \\ v_{C2} \end{bmatrix} + \begin{bmatrix} \frac{1}{L_1} & 0 \\ \frac{1}{L_2} & \frac{r_{C2}R}{L_2(r_{C2}+R)} \\ 0 & 0 \\ 0 & -\frac{R}{C_2(r_{C2}+R)} \end{bmatrix} \begin{bmatrix} v_S \\ i_Z \end{bmatrix}$$

OFF-state (Q turns off)

$$\begin{bmatrix} \frac{di_{L1}}{dt} \\ \frac{di_{L2}}{dt} \\ \frac{dv_{C1}}{dt} \\ \frac{dv_{C2}}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{1}{L_1}(r_{C1}+r_{L1}) & 0 & -\frac{1}{L_1} & 0 \\ 0 & -\frac{1}{L_2}\left(r_{L2}+\frac{r_{C2}R}{r_{C2}+R}\right) & 0 & -\frac{R}{L_2(r_{C2}+R)} \\ \frac{1}{C_1} & 0 & 0 & 0 \\ 0 & \frac{R}{C_2(r_{C2}+R)} & 0 & -\frac{1}{C_2(r_{C2}+R)} \end{bmatrix} \begin{bmatrix} i_{L1} \\ i_{L2} \\ v_{C1} \\ v_{C2} \end{bmatrix} + \begin{bmatrix} \frac{1}{L_1} & 0 \\ \frac{1}{L_2} & \frac{r_{C2}R}{L_2(r_{C2}+R)} \\ 0 & 0 \\ 0 & -\frac{R}{C_2(r_{C2}+R)} \end{bmatrix} \begin{bmatrix} v_S \\ i_Z \end{bmatrix}$$

Output voltage equation for both states:

$$v_O = \begin{bmatrix} 0 & \frac{r_{C2}R}{r_{C2}+R} & 0 & \frac{R}{r_{C2}+R} \end{bmatrix} \begin{bmatrix} i_{L1} \\ i_{L2} \\ v_{C1} \\ v_{C2} \end{bmatrix} + \begin{bmatrix} 0 & -\frac{r_{C2}R}{r_{C2}+R} \end{bmatrix} \begin{bmatrix} v_S \\ i_Z \end{bmatrix}$$

The weighted average matrices for ON-state and OFF-state are:

$$A = \begin{bmatrix} -\frac{r_{C1}(1-D)+r_{L1}}{L_1} & 0 & -\frac{1-D}{L_1} & 0 \\ 0 & -\frac{(r_{C2}+R)(r_{L2}+Dr_{C1})+r_{C2}R}{L_2(r_{C2}+R)} & \frac{D}{L_2} & -\frac{R}{L_2(r_{C2}+R)} \\ \frac{1-D}{C_1} & -\frac{D}{C_1} & 0 & 0 \\ 0 & \frac{R}{C_2(r_{C2}+R)} & 0 & -\frac{1}{C_2(r_{C2}+R)} \end{bmatrix}$$

$$B = \begin{bmatrix} \frac{D}{L_1} & 0 \\ \frac{D}{L_2} & \frac{r_{C2}R}{L_2(r_{C2}+R)} \\ 0 & 0 \\ 0 & -\frac{R}{C_2(r_{C2}+R)} \end{bmatrix} \qquad C = \begin{bmatrix} 0 & \frac{r_{C2}R}{r_{C2}+R} & 0 & \frac{R}{r_{C2}+R} \end{bmatrix} \quad E = \begin{bmatrix} 0 & -\frac{r_{C2}R}{r_{C2}+R} \end{bmatrix}$$

Zeta Converter Steady-state

U is consisted of two input variables which are $V_S$and I_Z. However, for the steady-state output equation, the goal is to find the relationship between output and input voltage. Thus only variable V_S is used for the derivation. However for I_Z multiplication, matrices B and E are included. For this reason, B and E matrices need to be separated into two matrices; B_S, E_S(for input variable V_S) and B_Z, E_Z (for input variable I_Z) which are presented as follow:

$$B = \begin{bmatrix} B_S & B_Z \end{bmatrix} = \begin{bmatrix} \frac{D}{L_1} & 0 \\ \frac{D}{L_2} & \frac{r_{C2}R}{L_2(r_{C2}+R)} \\ 0 & 0 \\ 0 & -\frac{R}{C_2(r_{C2}+R)} \end{bmatrix}$$

$$E = \begin{bmatrix} E_S & E_Z \end{bmatrix} = \begin{bmatrix} 0 & -\frac{r_{C2}R}{r_{C2}+R} \end{bmatrix}$$

To get an equation that relates the output and input voltage, the above equation (7) needs to be modified by replacing $U=V_S$, $B=B_S$ and $E=E_S=0$:

$$V_O = -CA^{-1}B_S V_S$$

or in circuit parameters form [1]:

$$V_O = V_S\left(\frac{D}{1-D}\right)\left(\frac{1}{1+\frac{r_{L2}}{R}+\frac{r_{C1}}{R}\left(\frac{D}{1-D}\right)+\frac{r_{L1}}{R}\left(\frac{D}{1-D}\right)^2}\right)$$

Zeta Converter Small-signal

Equation (6) is substituted into (9), thus the small signal state-space equation can be written as:

$$\tilde{x}' = A\tilde{x} + B\tilde{u} + \left[-(A_1 - A_2)A^{-1}BU + (B_1 - B_2)U\right]\tilde{d}$$

or

$$\tilde{x}' = A\tilde{x} + B\tilde{u} + B_d\tilde{d}$$

where,

$$B_d = -(A_1 - A_2)A^{-1}BU + (B_1 - B_2)U$$

in circuit parameters form [4]:

$$B_d = \frac{1}{R(1-D)^2\left[1+\frac{r_{L2}}{R}+\frac{r_{C1}}{R}\left(\frac{D}{1-D}\right)+\frac{r_{L1}}{R}\left(\frac{D}{1-D}\right)^2\right]}\begin{bmatrix} \frac{1}{L_1}\left[\left((1-D)(R+r_{L2})+Dr_{C1}\right)V_S - Dr_{L1}RI_Z\right] \\ \frac{1}{L_1}\left[(1-D)(R+r_{L2})V_S - \left(r_{C1}(1-D)+Dr_{L1}\right)RI_Z\right] \\ -\frac{1}{C_1}\left[DV_S + R(1-D)I_Z\right] \\ 0 \end{bmatrix}$$

Equation (10) is recalled, the small signal output equation is written as

$$\tilde{v}_O = C\tilde{x} + E\tilde{u} + \left[\left(C_1 - C_2\right)X + \left(E_1 - E_2\right)U\right]\tilde{d}$$

Since C_1=C_2 and E_1=E_2, the equation above is simplified as:

$$\tilde{v}_O = C\tilde{x} + E\tilde{u}$$

CONTROL OF ZETA CONVERTER USING FULL-STATE FEEDBACK CONTROLLER (FSFBC) AND OBSERVER (FSO)

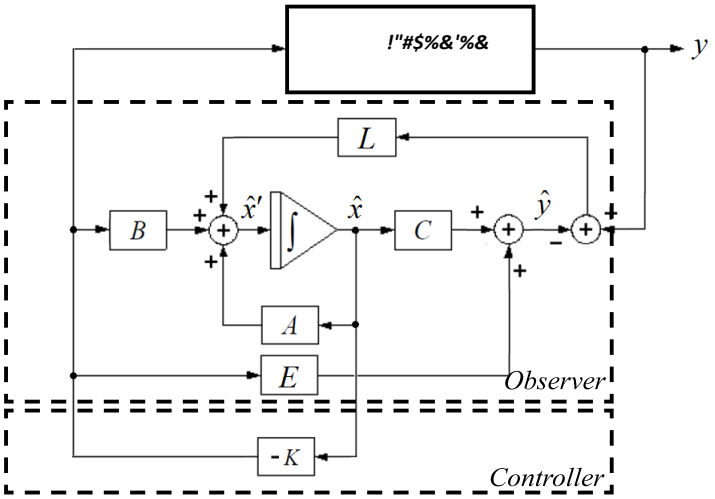

Fig. 5: An estimated full-state feedback controller

FSFBC Based on Pole Placement Technique

Desired poles must be placed further to the left handside (on s-plane) of the system's dominant poles location to improve the system steady-state error response. A good rule of thumb is that the desired poles are placed five to ten times further than the system's dominant poles location [5].For the full-state feedback controller, the closed-loop characteristic equation can be determined by:

$$\left|\lambda I - \left(A - BK\right)\right| = 0$$

FSFBC Based on Optimal Control Technique

To optimally control the control effort within performance specifications, a compensator is sought to provide a control effort for input that minimizes a cost function:

$$J = \int_0^\infty \left(x^T Qx + u^T Ru\right)dt$$

This is known as the linear quadratic regulator (LQR) problem. The weight matrix Q is an n x n positive semi-definite matrix (for a system with n states) that penalizes variation of the state

from the desired state. The weight matrix *R* is an *m x m* positive definite matrix that penalizes control effort [3].

To solve the optimization problem over a finite time interval, the algebraic Ricatti equation is the most commonly used:

$$PA + A^T P - PBR^{-1}B^T P + Q = 0$$

$$K = R^{-1}B^T P$$

where*P* is symmetric, positive definite matrix and *K* is the optimal gain matrix that is used in full-state feedback controller. Since the weight matrices *Q* and *R* are both included in the summation term within the cost function, it is really the relative size of the weights within each quadratic form which are important [6].

FSO State Estimation

The output of the estimator $\hat{y}$ can be compared to the output of the system, and any difference between them can be multiplied with an observer gain matrix *L* and fed back to the state estimator dynamics. Basically, the full-state observer has the form [7]:

$$\hat{x}' = A\hat{x} + Bu + Lz$$

where*z* is the difference between output and estimated output.

SIMULATION MODEL

Table I shows the parameters that are used for the zeta converter circuit. By substituting all the parameters in the state equations derived previously, the state matrices can be gathered as presented.

Table I: Zeta Converter Circuit Parameters

Circuit parameters	Values	Circuit parameters	Values
V_S	9V	Vo	24V
C_1	100uF	C_2	220uF
r_{C1}	0.8Ω	r_{C2}	0.35Ω
L_1	100uH	L_2	68uH
r_{L1}	0.034Ω	r_{L2}	0.029Ω
R	28Ω	f	100kHz

$$A = \begin{bmatrix} -2.38x10^3 & 0 & -2.55x10^3 & 0 \\ 0 & -1.43x10^4 & 1.10x10^4 & -1.45x10^4 \\ 2.55x10^3 & -7.45x10^3 & 0 & 0 \\ 0 & 4.49x10^3 & 0 & -1.60x10^2 \end{bmatrix} \quad [B_S \quad B_Z] = \begin{bmatrix} 7.45x10^3 & 0 \\ 1.2x10^4 & 5.08x10^3 \\ 0 & 0 \\ 0 & -4.49x10^3 \end{bmatrix}$$

$$C = \begin{bmatrix} 0 & 3.46x10^{-1} & 0 & 9.88x10^{-1} \end{bmatrix} \quad [E_S \quad E_Z] = \begin{bmatrix} 0 & -3.46x10^{-1} \end{bmatrix}$$

$$B_d = \begin{bmatrix} 3.50x10^5 \\ 4.75x10^5 \\ -3.36x10^4 \\ 0 \end{bmatrix}$$

$$p_{1,2} = (-7.00 \pm j9.91)x10^3 \qquad p_{3,4} = (-1.42 \pm j1.09)x10^3$$

Table II: FSFBC Gain for Various Pole Placement (Top) and Cost Function Weight (Bottom)

Pole placement	FSFBC gain, K			
	k_1	k_2	k_3	k_4
Poles 3x	0.42	-0.18	-0.14	3.66
Poles 5x	1.37	-0.76	-0.25	27.88
Poles 7x	1.81	-1.08	-1.82	108.67

Cost function weight	FSFBC gain, K			
	k_1	k_2	k_3	k_4
i_{L2}^2, v_{C2}^2	$1.14x10^{-3}$	$3.42x10^{-1}$	$2.24x10^{-2}$	$9.57x10^{-1}$
i_{L2}^2, $100v_{C2}^2$	$1.49x10^{-4}$	$5.23x10^{-1}$	$2.31x10^{-2}$	9.83
$100i_{L2}^2$, v_{C2}^2	$7.70x10^{-5}$	3.43	$2.24x10^{-2}$	$8.54x10^{-1}$

Table III: FSO Gain for Various Poles Placement

FSO gain, L	Poles placement		
	Poles 3x	*Poles 5x*	*Poles 7x*
l_1	$1.17x10^6$	$1.11x10^7$	$4.68x10^7$
l_2	$1.75x10^5$	$8.45x10^5$	$4.15x10^6$
l_3	$3.83x10^5$	$1.22x10^6$	$1.77x10^6$
l_4	$6.74x10^3$	$-1.71x10^5$	$-1.27x10^6$

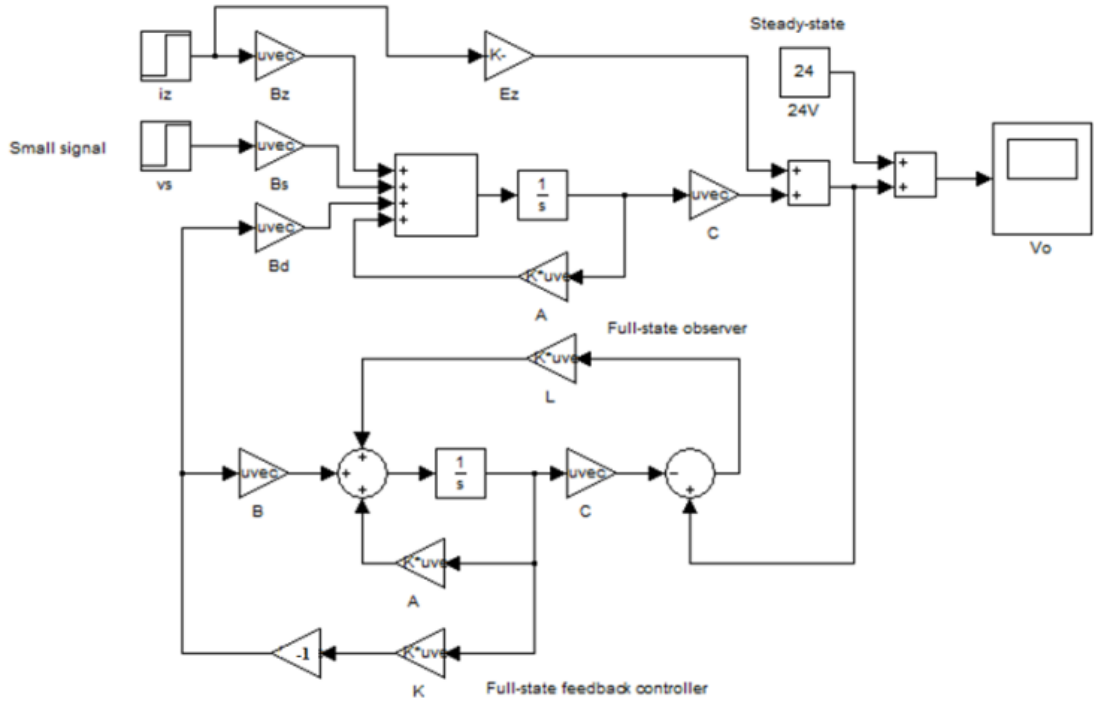

Fig. 9: Closed-loop zeta converter with full-state observer model

The eigenvalues for the zeta converter system can be calculated. *Poles 3x*, *Poles 5x* and *Poles 7x* refer to the pole location at 3 times, 5 times and 7 times further than the most dominant eigenvalues that is at $-7x10^3$ (real s-plane). FSFBC gain, *K* for various pole location and cost function weight are calculated for the closed-loop compensation and are shown in Table II. Table III on the other hand shows the FSO gain, *L* for the full-state observer. As for the Simulink model, the zeta converter open-loop with the implementation of full-state observer and controller is shown in Fig. 6.

RESULTS

For the open-loop, when subjected to input voltage disturbance of $\tilde{v}_S=1V$, the output increased significantly to approximately 27V while for load current disturbance of $\tilde{i}_Z=1A$, the output decreased to about 21.6V (Fig. 10). This response to disturbance is very undesirable. To reduce the effect of the disturbances, full-state feedback controller is used. The controller is designed based on pole placement and optimal control technique. When subjected to input disturbance of $\tilde{v}_S=1V$, the response is shown in Fig. 11. In the figure, the pole location that yield the best compensation is *Poles 7x* with output voltage of 24.006V. whilecost function weight i_{L2}^2, $100v_{C2}^2$ produced the best compensator with the output voltage of 24.002V for optimal control technique. On the other hand, when subjected to load current disturbance of $\tilde{i}_Z=1A$, again *Poles 7x* (23.95V) and i_{L2}^2, $100v_{C2}^2$ (23.95V) produced the best results as shown in Fig. 12.Table IV shows the summary of the voltage regulation when subjected to input voltage disturbance and/or load current disturbance for FSFSC based on pole placement and optimal control technique. It is required that the VR is $\leq \pm 1\%$. For pole placement technique, only pole location at *Poles 7x* can achieve this requirement while for optimal control technique, i_{L2}^2, $100v_{C2}^2$ can be used for the output voltage regulation requirement. Since both pole placement and optimal control technique can achieve required voltage regulation requirement, it is up to individual to choose their preference technique.

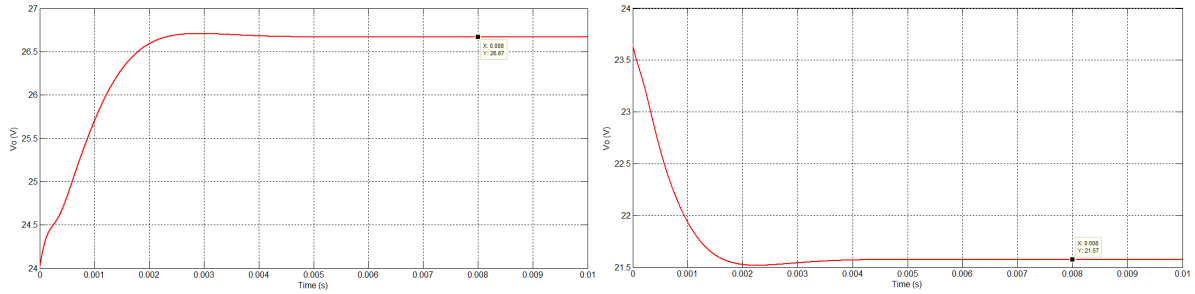

Fig. 10: Open-loop output voltage, V_O response to disturbance $\tilde{v}_S$=*1V*(left) and $\tilde{i}_Z$=*1A* (right)

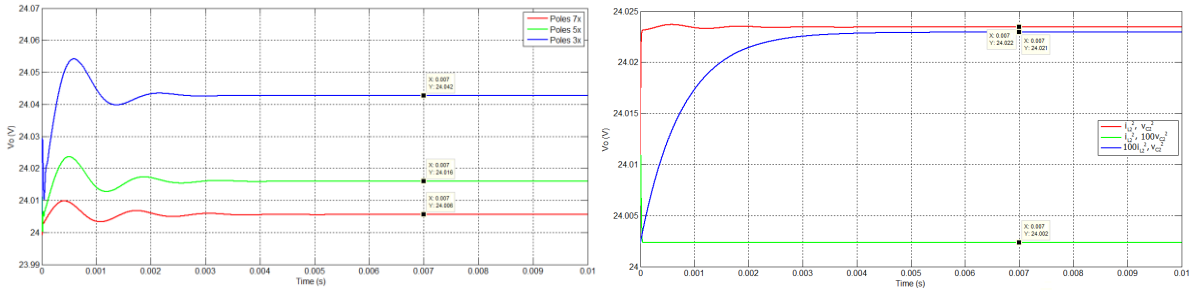

Fig. 11: Compensated output voltage, V_O response to disturbance $\tilde{v}_S$=*1V* using FSFBC based on:pole placement (left) and optimal control technique (right)

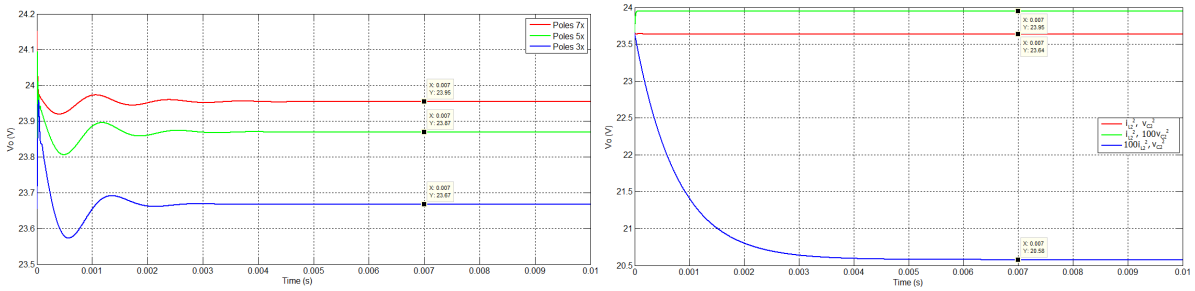

Fig. 12: Compensated output voltage, V_O response to disturbance $\tilde{i}_Z$=*1A* using FSFBC based on:pole placement technique (left) and optimal control technique (right)

Table IV: Output Voltage Regulation Using FSFBC Based On Pole Placement and Optimal Control Technique Comparison

	Pole Placement			Optimal Control		
	Poles 3x	*Poles 5x*	*Poles 7x*	i_{L2}^2, v_{C2}^2	i_{L2}^2, $100v_{C2}^2$	$100i_{L2}^2$, v_{C2}^2
$Vs = 9V \pm 25\%$, $I_Z = 0A$	±0.40%	±0.15%	±0.05%	±0.22%	±0.02%	±0.22%
$Vs = 9V$, $I_Z = 4A$	-5.55%	-2.18%	-0.76%	-6.06%	-0.92%	-57.05%
$Vs = 9V + 25\%$, $I_Z = 4A$	-5.15%	-2.03%	-0.71%	-5.84%	-0.89%	-56.83%
$Vs = 9V - 25\%$, $I_Z = 4A$	-5.95%	-2.33%	-0.81%	-6.28%	-0.94%	-57.26%

CONCLUSIONS

In this paper, modeling and control of a zeta converter operating in Continuous Conduction Mode (CCM) has been presented. The state-space averaging (SSA) technique was applied to find the steady-state equations and small-signal linear dynamic model of the converter. To ensure the output voltage maintain at the desired voltage regulation requirement, full-state observer and controller are used as the controller. To compensate the output voltage from the input voltage and load current disturbances, feedback controller gain for *Poles 7x* and (i_{L2}^2, $100v_{C2}^2$) is proven to produce the best compensated output voltage for FSFBC based on pole placement and optimal control technique, respectively.

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Hafez Sarkawi
Faculty of Electronics and Computer Engineering (FKEKK),
University Technical Malaysia Melaka (UTeM), Melaka
hafez@utem.edu.my(+606-5552025)

Mohd Hafiz Jali
Faculty of ElectricalEngineering (FKE),
University Technical Malaysia Melaka (UTeM), Melaka
mohd.hafiz@utem.edu.my(+606-5552331)

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Cause of Poor Power Quality in Small Industry in Sarawak

Kang Chia Yang & Hushairi Hj Zen

ABSTRACT

Power quality is used to describe the degree of consistency of electrical energy expected from generation source to point of use. The term power quality refers to a wide variety of electromagnetic phenomena that characterize the voltage and current at a given time and at a given location on the power system. Power quality problems can be defined as problem that results in failure of customer equipments, which manifests itself as an economic burden to users, or produces negative impacts on the environment. Voltage stability, power factor, harmonics pollution, reactive power and load unbalance are some of the factors that affect the consistency or the quality level. This research proposal proposes to investigate and analyze the causes and effects of power quality to homes and industries in Sarawak. The increasing application of electronics equipment used in the industries and homes has caused a big impact on the power quality. Many electrical devices are now interconnected to the power network and it can be observed that if the power quality of the network is good, then any loads connected to it will run smoothly and efficiently. On the other hand, if the power quality of the network is bad, then loads connected to it will fail or may cause damage to the equipments and reduced its lifetime. The outcome of this research will enable better and novel solutions of poor power quality to homes and industries and reduce damage of electrical devices at home and products in the industries.

Keywords: *Power Quality, Harmonic distortion, Power Network, Voltage Sag*

INTRODUCTION

In recent years, there has been an increased emphasis and concern for the quality power delivered to factories, commercial establishments and residences. Much of the equipment in use today is susceptible to damage or service interruptions during poor power quality events [1]. There has been a proliferation of non linear loads in electrical installations due to the great development of electronic equipment. As widely known, everyone using computer whether at home or office has experienced a computer shutdown and reboot, due to power outage which result in loss of working hours. This is caused by the poor power quality on the 240V line. Quality of Electricity is very essential for modern industry. Almost all offices and industrial equipment depend on electricity in some form or the other. Heavy industrial equipments like non-linear variable speed drives powered through power electronic converters may cause power disturbances. Due to this, power quality is becoming a mounting concern in the electric power industry. Power quality problems encompass a wide range of disturbances and conditions on the power system. They include everything from very fast voltage transients to long duration outages. It

also includes steady state phenomena such as flicker and noisy waveforms. The power system can also experience momentary interruptions like voltage sag and swell. These problems are sometimes unpredictable, because it is difficult to predict when and where it might happen. Poor electric power quality basically was limited to interruptions in the energy supply, however currently many other factors influence the quality of energy, since the number of sensitive loads is increasing at the same time that the non-linear current consumption augments the voltage waveform distortion. The Institute of Electrical and Electronics Engineers (IEEE) has attempted to address this problem by developing a standard that includes definitions of power disturbances. This standard, IEEE Standard 1159-1995, IEEE Recommended Practice for Monitoring Electrical Power Quality, defines disturbances as: interruptions, sags and swells, long duration variations, impulsive transients, oscillatory transients, harmonic distortion, voltage fluctuations, and noise. Therefore the power quality monitoring standard is very effective to prevent future problems that might cause damage of equipments or premature aging of the installation components like transformers, circuit breakers. The electrical wiring might also be affected. Monitoring of electrical power quality is perhaps the most important, step in identifying and solving power problems [2].

PROBLEMS STATEMENTS

The widespread use of electronics devices ranging from equipment at home to the control of huge and costly industrial processes has raised the awareness of power quality issues and concerns over the last few years. Low power quality issue has seriously affected the small industry and resulted in financial loss due to the stop of production and wasted electrical power distributed to homes, especially the non-linear characteristics of various offices and industrial equipments connected to the power grid which might cause electrical disturbances. Some electronic equipment, beyond consuming distorted currents, also requires rigorous parameters of electric energy, meaning that a small disturbance may cause malfunction or even in the most extreme cases, cause serious damage. Circuit Breakers tripping for no apparent reason, computer malfunction, communication failure, conductor failure of heating, electronic equipment shutting down, flickering of fluorescent lights, fuse blowing, motor failures and overheating are some of the effect due to poor power quality. All this phenomena potentially lead to inefficient running of installations, system down time and reduced equipment life and consequently high installation running costs. Study needs to be carried out to investigate the causes and effects of the poor power quality in Sarawak so that solutions can be designed. It also aims to give readers a better insight in the benefits that may be gained by having good Power Quality in installations.

OBJECTIVES

This proposed paper aims to identify, study, and analyze the electrical devices that are used in homes and small industries in Sarawak and the impacts they may present to power quality. It also attempts to study the power quality problem such as harmonic distortion and voltage sag on a power line that may be caused by typical loads using computer models paving the way to identify the source of the problem. Reliability of supply and voltage quality is to be studied by using method of monitoring the power waveform. Power quality monitoring is an essential service

many utilities perform for their industrial and other key commercial customers. The results of this study will contribute knowledge for researchers to design a more efficient power to reduce power waste either as a result of reactive or capacitive losses, harmonic distortion and other losses such as load imbalance. Other than that, it also contributes to overcome problems such as energy loss and malfunction of electrical equipment due to the poor power quality.

LITERATURE REVIEW

Harmonic distortion is one of the main factors that contributes to poor power quality and was observed when the sinusoidal voltages or currents have frequencies that are integer multiples of the fundamental frequency being supplied. This distortion is continuous and the most common result is unwanted heating in the electrical system. It is interesting to note that some of the equipment that is sensitive to power quality disturbances is often equipment that generates harmonics. Equipment such as adjustable speed drives, computer power supplies, UPS equipment and other power electronics create harmonic currents. Harmonic currents generate harmonic voltages as they pass through the system impedance. In addition to power electronics, arcing equipment such as arc furnaces and welders are also major contributors in the harmonic arena [3].

The monitoring of Electric Power Quality is an important tool to detect problems that may be affecting the equipment or the electrical installation. An effective Power Quality Monitoring may also prevent future problems that might cause damage of equipments or premature aging of the installation components like transformers, circuit breakers even the electrical wiring can be affected. Power Quality Monitor prototype was developed at Energy and Power Electronics laboratory of the University of Minho. This prototype is assembled in a strong plastic case with easy to connect plugs for power and sensors and a built-in 14 inch TFT monitor. To allow the Electric Power Quality Monitor to record the consequences of the failure and also the consequences of the return of the electric power, the prototype was equipped with a backup battery, so, it continues working in the occurrence of power outages. The software of the Electric Power Quality Monitor is constituted by several applications and is based in *Lab View*. The developed applications allow the equipment to function like a digital oscilloscope, analyze harmonic contents, detect and record voltage distortions (sags, swells, interruptions, wave shapes), measure energy, power, voltage and current unbalance, power factor, record and watch strip charts and generate reports [4].

Harmonic field measurement is done to verify the degree of severity of harmonic distortion due to domestic non-linear loads in the distribution system [5]. There are number of solid state controlled non-linear equipments are used for domestic application such as electronic fan regulator, personnel computer, printer, etc. These non-linear loads inject harmonic currents in the network thus distorting supply voltage. In carrying out harmonic measurement, six types of domestic application were selected. All the measurements are made at 230 V using Yokogawa make clamp on type Power Analyzer. Harmonic spectrum for each load is plotted showing magnitude of each harmonic frequency that makes up a distorted waveform. The magnitude of each harmonic frequency can be expressed as a percentage of fundamental. Total harmonic distortion is defined from harmonic spectrum as the ratio of the RMS sum of all harmonic frequencies to the RMS value of the fundamental [6].

There is no single algorithm that can detect the variety of power quality anomalies. Instead, a set of algorithms is need, where each one is responsible for detection of a set of disturbances. The IT group expertise in analog to digital converters (ADCs) testing/characterization and in digital signal processing algorithms will be used in the development of power quality analyzers. The use of ADCs and digital signal processing algorithms will enable the development and implementation of instruments with great versatility which can be easily adapted to the anomalies that degrade power quality [7].

The power consumption in Brazil is constantly increasing; all electrical equipments connected to an electric power system are designed to work in a particular nominal voltage. The efficiency of industrial processes is directly related to the Power Quality (PQ) delivered to customers, since most of the equipments that compose these processes have different levels of vulnerability in relation to disturbances in the Power Quality [9]. The recent standard PRODIST forces all utilities to meet the requirements. An analysis regarding the power quality parameters covered by Prodist are steady state voltage magnitude, power factor, voltage harmonics, voltage unbalance, voltage fluctuation (flicker), voltage variation and frequency variation. The goal is to present aspects to be observed in the measurement of each parameter indicating the standard in which the measurement is based, technical characteristics, measurement methodology and criteria accuracy that must be observed [10].

Power quality becomes an emphasis of related researches. The functions of QCC are expanded and its basic types and structures are defined based on the detailed study on QCC (Quality Control Center) of the FRIENDS. The technological core of FRIENDS is called the electric power QCC (Quality Control Center), which can realize the power supply of different kinds of qualities and different kinds of electric energy forms, moreover it has the functions of information processing and control center. The supply of many kinds of electric energy qualities includes: premium quality power supply, high quality power supply and normal quality power supply. The supply of different kinds of electric energy forms includes: AC power supply and dc power supply. Thus high flexibility, high reliability, and intelligence of power supply can be achieved by QCC. The conventional distribution system with QCC is called flexible distribution system. A profound research on QCC and its key part UPQC has been present [8].

RESEARCH METHODOLOGY

This research proposes a study on the causes and effects of power quality in industries and homes in Sarawak. It will be carried out in several stages: as below:

Stage 1:

Surveys and interviews with engineers in small industries and occupants of homes in Sarawak, monitoring the power waveform of the load system on the small industry to identify the problems of misoperation. Process of monitoring needs to be done periodically at regular interval. A series of data will be collected during process of monitoring.

Stage 2:

Preparing a network model of the electrical system. The data on power outages and breakdown collected from industry will be used to carry out simulation using PSCAD or any other appropriate simulation tools. It will be simulated by using suitable parameters on the non-linear loads.

Stage 3:

The simulation results will be used to design or recommend a solution to improve and overcome the issue of power quality in industries and homes in Sarawak.

VOLTAGE SAG CAUSE BY LARGE INDUCTION MOTOR STARTING

One of the analyses in this study is carrying out on the small industry. High starting current of the motor often lead to unwelcome voltage drops to an unacceptable value in the supply network and the high starting torque put the mechanical elements under considerable strain. The voltage sag cause by large induction motor starting will be examined. Every power and source has their own impedance. When there is heavy loads at starting, voltage sag was happens on the feeders due to the large impedance. They are supplied through two transformers with ratings of 1MVA, 11KV/415V. The currents for the large induction motor sometimes can be several times higher than the rated load currents due to the heavy loads. This higher currents can be represents a very high load across the electrical system. The presence of the voltage sags has the effect of causing motor to draw more currents and results in trip of the electrical network. The following figures illustrate a simple model of the electrical network with two large induction motor in simulation of voltage sag that cause by large induction motor starting. An overlay graph with signal was measure in the feeder of the system.

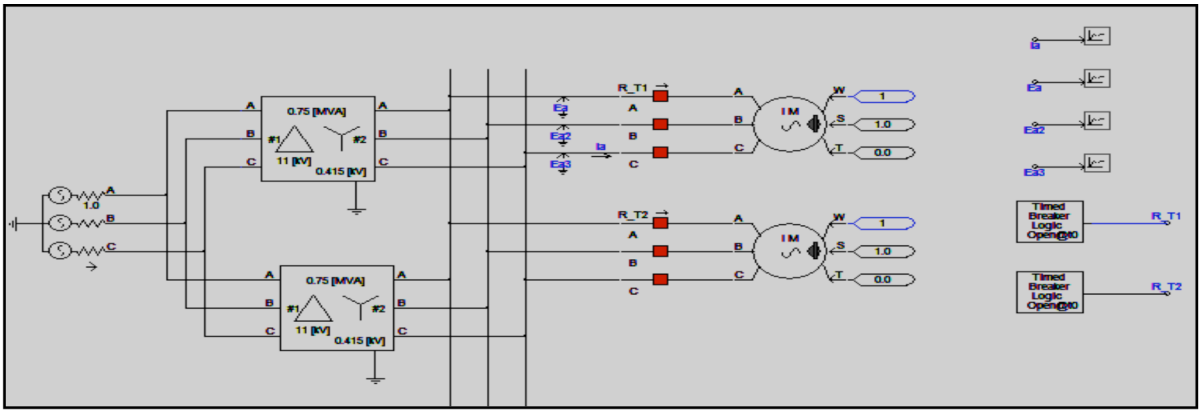
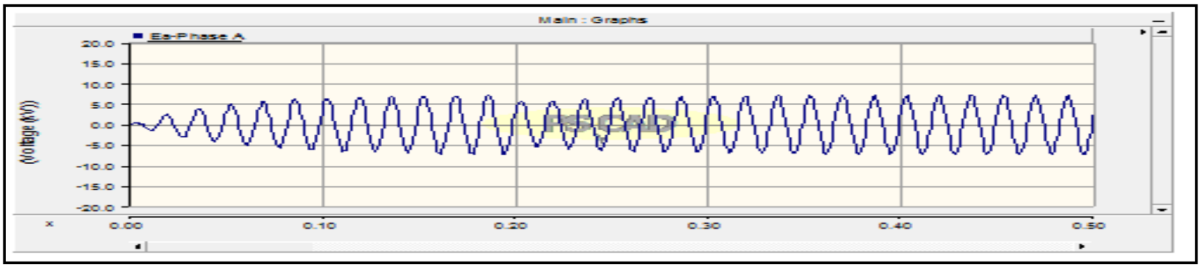


Figure 6.1: Simple Large Induction Motor Starting at Small Industry

RESULT AND ANALYSIS

Phase A:



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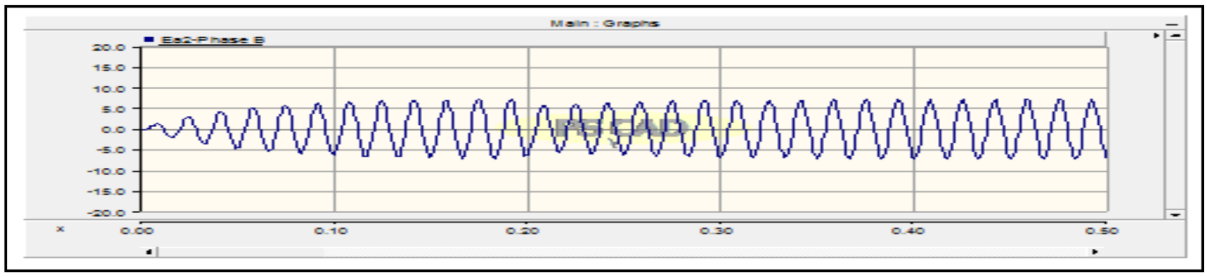

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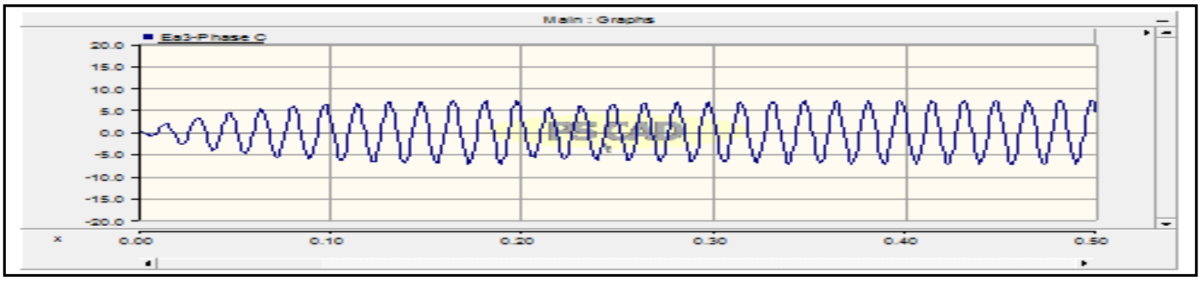

Figure 7.1: Voltage Sag effect that Cause by Large Induction Motor during Starting

In the initial state, the induction motors are in the off situation and the switches are opened. Once the switch are closed at 0.2s, the induction motor draw a bit higher than the rated load current and the voltage is slightly decreasing during starting. The phenomenon is known's as voltage sag. Voltage Sag is happens start from 0.2s and will remain until it reached the nominal speed. Normally the duration of the voltage sag will be stay for several seconds. The parameter of the simulation was modeled according to the data from the survey result. The results obtained have illustrated the effect of the large induction motor on the small industry.

CONCLUSION

Simulation of voltage sag by using computer aided tools PSCAD in the power distribution system has been carry out as part of this research. Voltage sag in this thesis is concentrate on the small industry. The purpose is to find out the cause and the effect of the low power quality. The results obtained were realistic if compare with the theoretical results. The loading effect on the starting

was causing the high starting current and leading to the voltage sag. Decreasing of the voltage magnitude on 0.2s shows that the poor power quality in the power system. The results of the simulation will assist in the future study and development in the power system network. Therefore more works should be carrying out in this area so that to improve the power quality problems.

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Kang Chia Yang
Department of Mathematics, Science & Computer
Polytechnics Mukah Sarawak
Email: kangcy87@hotmail.com

Dr. Hushairi Hj Zen
Department of Electronics
Faculty of Engineering, University Malaysia Sarawak
Email: zhushair@feng.unimas.my

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Design and Implementation of Secure Attribute-Based Encryption Framework for Body Sensor Networks

Yar-Ling Tan, Bok-Min Goi, Ryoichi Komiya & Raphael C.-W. Phan

ABSTRACT

Badan rangkaian sensor (Body sensor network (BSN)) adalah sejenis rangkaian yang terdiri daripada sensor-sensor yang melampiri bahagian-bahagian badan untuk mengumpul pelbagai isyarat fisiologi demi pemantauan kesihatan. Data yang dikumpul dari nod-nod sensor akan dihantar kepada pembekal kesihatan dan disimpan dalam server. Data yang berada dalam server boleh dikongsi oleh kakitangan pusat kesihatan yang diotorisasikan untuk memantau keadaan kesihatan pesakit. Justeru itu, untuk memastikan privasi, kerahsiaan dan fleksibiliti dalam menetapkan hak akses individu pada data yang disulitkan, penyulitan berasaskan sifat (Attribute-Based Encryption (ABE))adalah pilihan yang paling sesuai.Kami mencadangkan implimantasi untuk rekaan dan rangka kerja penyulitan berasakan sifat polisi kunci (Key Policy ABE (KP-ABE)) untuk BSN.Kami telah menreka dan mempamirkan prototai psistempen sulitan/penyah sulitan dengan KP-ABE dalam BSN.

Keywords: attribute-based encryption, body sensor network, privasi,kesihatan

INTRODUCTION

Body sensor network (BSN) [1-4], is a type of wearable network associated with computing device. The body sensor network has been brought forth by the advancement of today's medical industry, called as telemedicine.The current improvement and enhancement of technologies in BSN has madepossible the distributed monitoring of patients outside the hospital.BSN is composed of wearable computing device with a set of sensors attached todifferent part of human body to collect vital signs. The vital signs collected are body temperature, blood pressure, pulse rate (or heart rate), body motion and SpO2. BSN is a wireless network that enables sensors to send the vital signs to mobile computing device (e.g. smartphone) or a computing unit. Then, the collected vital signs will be sent to the third party server site to be stored. In this way, patient can be monitored remotely from the hospital [5].With the deployment of body sensor networks, hospital stay could be reduced and the bed occupancy will be improved. This helps to promote a better future trend of national health services. This will ease the problem such as shortage of hospital beds. Besides that, the family members can also help to take care of the patients outside of hospital. BSN can be used on patients who are under treatment or after surgery. Furthermore, it can also be used for early detection and prevention of any possible life threatening abnormalities. Early detection of disease symptoms by using the BSN could ease the treatment by the healthcare provider and could prevent the deterioration of the illness.As the vital signs are very important

data for the healthcare provider, these data needs to be protected from being altered or removed. Slight alteration or removal on these data could bring harm or even death of the patients due to the wrong treatment given based on the medical health data of the patient.

Therefore, all the vital signs will need to be encrypted before sending to the server.The vital signs stored at the server will be shared among different users (e.g. doctors, nurses, pharmacies, patient and etc.). Thus, privacy, confidentiality and security issues for these vital signs shouldbe a major concern in this topic. Therefore, it is important for the vital signs to be encrypted before sending to the third party servers. Encryption is one of the potent approaches to secure vital signs. Various research works have been carried out to counteract the security issues in BSN [6-10]. Attribute-based encryption (ABE) [11-14], is a fine-grained access control system, which enables a set of users to have different access rights. ABE have two major types which are the key-policy attribute-based encryption (KP-ABE) [15-16], and ciphertext-policy attribute-based encryption (CP-ABE) [17-19]. In our work, we propose an implementation of KP-ABE scheme to apply the encryption to patient's vital sign.We have designed a framework and prototype of KP-ABE for BSN.

BACKGROUND

Cryptography is aim to enable users to communicate with one another securely over an insecure channel by constructing schemes or protocols. This is a way to ensure users' transmission of data which high privacy and confidentiality is protected.

In 1984, Shamir introduced a novel type of public encryption scheme called Identity-Based Encryption scheme (IBE) [20], which enable users to securely communicate, verify and exchange each other's signatures without any exchange of private or public keys. Thus, eliminates the need to keep key directories. Instead of generating a random pair of public/secret key and made the public key known to everyone, the public key can be in a form of any arbitrary string. For example, names, home address, phone number, e-mail address and etc. provided that they can uniquely identify the use which he cannot later deny.In year 2001, Boneh and Franklin proposed the first secure and practical IBE [21] from the Weil pairing on elliptic curves.

In 2005, Sahai and Waters introduced a new type of IBE scheme called Fuzzy Identity-Based Encryption (FIBE) [11]. In IBE, identities are viewed as arbitrary strings. While in FIBE, identities are being viewed as a set of descriptive attributes. FIBE scheme allows a user with private key corresponding to a set of identity, *ID* to decrypt a ciphertext encrypted with the public key, *ID'* if and only if *ID* and *ID'* overlap each other by some distance metric, *d*. Therefore, FIBE system allows a certain amount of error-tolerance in the identities. In this paper, the authors also mentioned on the application of FIBE termed as Attribute-Based Encryption (ABE). In an ABE system, a user's key and ciphertext are labeled with a set of attributes. A particular key can decrypt a particular ciphertext only if there is a match between the attributes of the user's key and ciphertext.

After ABE was first introduced in the work of Sahai and Waters, in year 2006, Goyal et al. proposed the Key-Policy Attribute Based Encryption (KP-ABE) for fine-grained sharing of encrypted data [15]. Encryption of vital signs usually limits the ability of encrypted vital signs to be shared among different users. In other words, the encrypted vital signs can only be selectively

shared at a coarse-grained level. For example, in order to perform vital signs decryption, patient needs to give his/her private key to another party. This somehow allows another party to have all the access of the patient's vital signs. Another alternative, patient can act as an intermediary to perform decryption on the relevant vital signs but can be arduous. Both approaches do not seem appealing as they are not practical and inefficient.

Fine-grained sharing of encrypted data enables different authorized users to retrieve and decrypt ciphertext based on their access policy. The access policy embedded in the user's key specifies the type of ciphertext that the user's key is allowed to decrypt. In KP-ABE, each ciphertext is labeled with a set of descriptive attributes, while the access policy is embedded in the user's key. User is able to decrypt a ciphertext if the access policy of user's key matches the descriptive attributes labeled at the ciphertext. KP-ABE scheme is able to grant different access rights to different users.

In year 2007, Bethencourt et al. provides the first construction of a ciphertext-policy attribute-based encryption (CP-ABE) scheme [17]. In CP-ABE scheme, private key is labeled with a set of descriptive attributes, while the access policy is associated with the ciphertext. A user is able to decrypt the ciphertext if his attributes satisfy the access policy associated to the ciphertext.

PROTOTYPE AND FRAMEWORK

Our prototypeis setup by attaching body sensors to human body to record vital signs. Vital signs that we collect are body motion and heart rate. Vital signs are then sent from the sensors to a personal computer via Bluetooth. KP-ABE encryption process is carried out in the personal computer. The encrypted vital signs will be sent to the server. Authorized parties will be able to retrieve and decrypt the vital signs according to their access rights. Fig. 1 shows the prototype of our system. We propose the implementation of KP-ABE encryption scheme as the encryption scheme for vital signs because the efficiency, access control, assignment of attribute and access policy and hardware implementation of KP-ABE encryption scheme are more desirable and suitable as compared to CP-ABE [22-23].

Fig. 1: Prototype of KP-ABE for Indoor Mobile Healthcare System

Body Sensor

Body sensor unit (SH-CDK-KIT-003)shown in Fig. 2, is a small, lightweight and wearable sensor platform used to record electrocardiogram (ECG) and three-dimensional body motion. The ECG leads connects the sensor unit to the conventional disposable electrodes which are attached to the human body. Heart rate and 3D body motions are then recorded via the sensor unit.

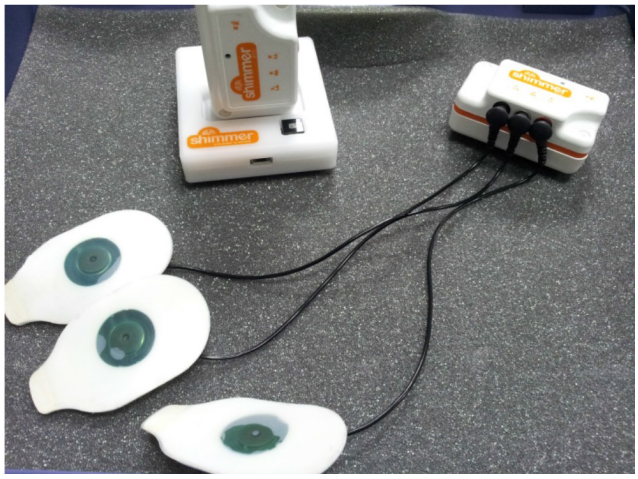

Fig. 2: Body Sensor Unit

Mobile Computing and Storage Server

Our work is performed in Ubuntu operating system. Charm framework [24] is used to build our cryptographic prototype.The programming language used is Python. We utilized a personal cloud to store and access encrypted files. The personal cloud allows to store, to access and to share files across different platforms and devices.When the heart rate and 3D motions reading are recorded using the sensor unit, the vital signs readings will be sent to the patient's personal computer. Then, the personal computer will act as a hub to collect all the vital signs and perform KP-ABE encryption.

In KP-ABE scheme, the vital signs are encrypted with a set of descriptive attributes. The private key is embedded with a set of access policy. The private key is being issued by the third party key generator. After the vital sign readings are being encrypted, the ciphertext will be sent to the storage server to be stored.The hospital professionals will access, retrieve and decrypt the storedciphertext.

KP-ABE scheme consists of four algorithms [15].

1. Setup (1^k): The setup algorithm takes as input a security parameter, 1^k and outputs the public parameters, *PK* and a master key, *msk*which is known only to the private key generator (PKG).
2. Enc (*m, PK, γ*): The encryption algorithm takes as input a message, *m*, a set of attributes, γ and the public parameters, *PK*. It outputs the ciphertext, *c*.
3. KeyGen (*PK*, msk, $\mathbb{A}$): The key generation algorithm takes as input the public parameters, *PK*, the master key, *msk* and an access policy, $\mathbb{A}$. It outputs the private key, $D_{\mathbb{A}}$.

4. Dec (c, PK, $D_{\mathbb{A}}$): The decryption algorithm takes as input the ciphertext, c which was encrypted under the set of attributes, γ, the public key parameter, PK and the private key, $D_{\mathbb{A}}$ for access control policy, $\mathbb{A}$. It outputs the message m if $\gamma \in \mathbb{A}$.

Features

There are 2 features in our implementation which is the store-and-forward and real-time medical data transmission mechanism shown in Table 1. In store-and-forward, patients encrypt the vital signs and send the vital signs to the storage server at any time or any day. In our system, store-and-forward medical data encryption can be performed in two methods. The first method is hand-operated where encryption is manually performed by patient in a direct manner. The second method is self-starting where encryption is performed automatically by the system at a certain time period (e.g. hourly basis, daily basis, weekly basis or certain time of the day in a week). Time for medical data transmission can be flexibly changed accordingly. For real-time mechanism, patients' vital signs will be encrypted and sent to storage server at a continuous basis. Table 2 shows the comparison of our store-and-forward and real-time encryption in our prototype.

Table 1: Store-and-forward and real-time medical data transmission mechanism

Store-and-forward	Real-time
1. Vital signs are sent from body sensor nodes to PC. 2. PC assembles the vital signs and save them in a file. 3. PC encrypts the file and sends to server at certain time period. Encryption can be done either by hand-operated or self-starting. 4. Hospital personnel retrieve the encrypted vital signs and perform decryption to regenerate the original vital signs.	1. Vital signs are sent from body sensor nodes to PC. 2. PC receives the vital signs packets and encrypts the vital signs. 3. Encrypted vital signs packets are sent to server packet by packet basis. 4. Hospital personnel retrieve the encrypted vital signs and perform decryption to regenerate the original vital signs.

Table 2: Store-and-forward vs. real-time encryption differences

Features	Store-and-forward	Real-time
Data type	File	Packet
Encryption basis	Hourly, daily, weekly, monthly	Approximately 0.02sec for sample rate of 50Hz

Framework

We have designed and proposeda framework design of KP-ABE for BSN which is shown in Fig. 3. Table 3 shows the functions of each component in the framework of KP-ABE for BSN.

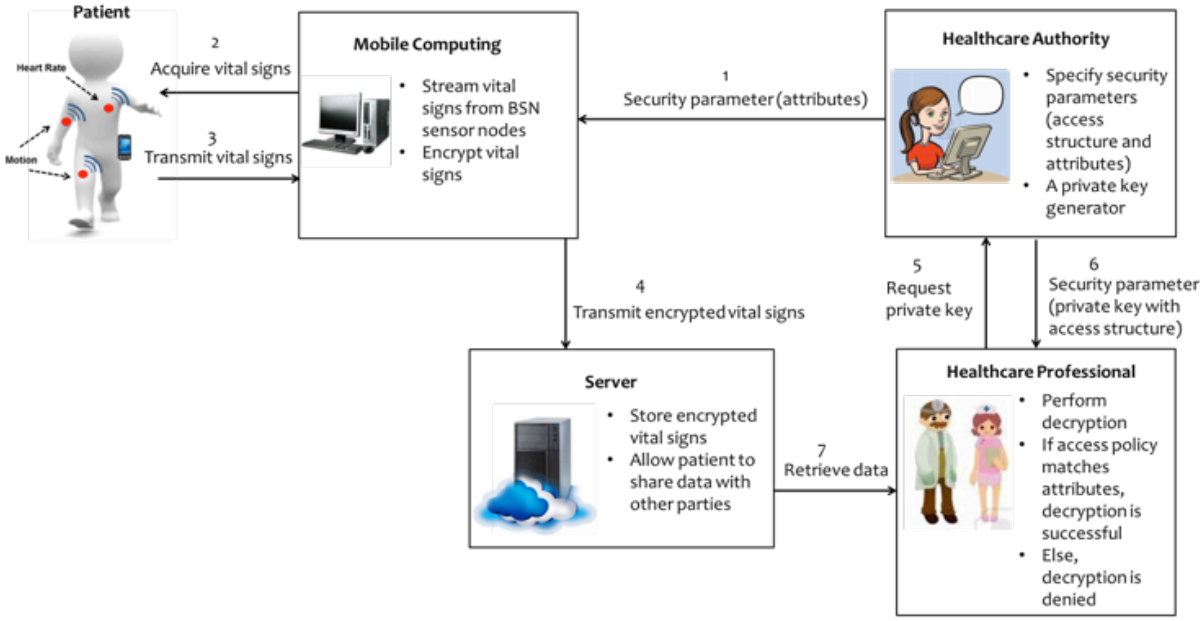

Fig. 3: Framework of KP-ABE for BSN

Table 3: Functions of each component in the framework of KP-ABE for BSN

Component	Functions
Patient's Mobile Computing	Stream vital signs from BSN sensor nodes. Encrypt vital signs.
Healthcare authority	A private key generator. Specify security parameters (access structures and attributes).
Server	Store encrypted vital signs. Allow patients to share data with other parties.
Healthcare professionals	Diagnose and analyse patients' vital signs.

RESULTS OF EXPERIMENT

Section 4 shows the results of the experiment. The results shown are correct encryption and decryption as well as the incorrect encryption and decryption.

Correct Encryption and Decryption

Fig. 4 shows the screenshot of the work. The vital signs are being encrypted with a set of attributes at the patient's site and then sent to remote server site. In order to decrypt the encrypted vital signs, the access policy embedded in the private key must match the attributes encrypted in the vital signs.

Incorrect Encryption and Decryption (Decryption using incorrect private key)

From the screenshot shown in Fig. 5, the encrypted vital signs are being decrypted with an incorrect private key. The encrypted vital signs cannot be decrypted and the original vital signs

Fig. 4: Screenshot of correct encryption and decryption

cannot be reconstructed as the embedded access policy in the private key does not satisfy the attributes encrypted in the vital signs.

CONCLUSIONS AND FUTURE WORKS

We have designed and presented the prototype of a secure healthcare system to protect the captured vital signs of patientswith KP-ABE encryption and to connect the patient's mobile computing to storage server. Healthcare professionals are able to retrieve patient's personal vital sign records respectively from the storage server. This enables patients' medical datato be remotely monitored fromthe hospital insecured manner. In this way, mobile portable telemedicine system with high security for patients' medical data has been confirmed by this project.

In future work, we will look into the security analysis in our current framework and also handle the issue of healthcare professional immediate private key revocation.This would accelerate the commercial introduction of telemedicine system in the country.

Fig. 5: Screenshot of encryption and decryption using incorrect private key

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Yar-Ling Tan
UniversitiTunku Abdul Rahman
yarling@1utar.my
+603-41079802

Bok-Min Goi
UniversitiTunku Abdul Rahman
goibm@utar.edu.my,ryoichi@utar.edu.my
+603-41079802

Ryoichi Komiya
UniversitiTunku Abdul Rahman
ryoichi@utar.edu.my
+603-41079802

Raphael C.-W. Phan
Multimedia University
raphael@mmu.edu.my
+603-8312 5610

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Real-Time Optimal Control Technique of A Rotary Inverted Pendulum System

M.A.H.M.Nazri, M. H. Jali & H. Sarkawi

ABSTRACT

This paper presents a real time control technique to stabilize inverted pendulum in the vertical upright position. Stabilize the inverted pendulum is a classical control problem that could be related to some problems in industrial applications. Two common problems that always been encountered by inverted pendulum system is unstable behavior and nonlinear. This lead to numerous studies on the control algorithm to balance the inverted pendulum system in the vertical upright position. Generally, inverted pendulum is mounted on DC motor and is equipped with sensor to measure angular displacement. Inverted pendulum has the same analogy with human that try to balance a broomstick using fingertip. Balancing the Inverted Pendulum requires a good control system. Therefore an optimal control technique is proposed to achieve desired design requirement which are less than 5% overshoot and less than 5 seconds settling time. The controller is optimized to achieve the best performance result. Finally the performance of the controller is compared with PID controller as a benchmark.

Keywords : Inverted pendulum, optimal control, nonlinear, unstable

ABSTRAK

Kajian ini membentangkan teknik kawalan masa sebenar untuk menstabilkan sistem bandul songsang dalam kedudukan tegak menegak. Menstabilkan bandul songsang adalah masalah kawalan klasik yang boleh dikaitkan dengan beberapa masalah dalam aplikasi industri. Dua masalah biasa yang sentiasa dihadapi oleh sistem bandul songsang adalah tingkah laku yang tidak stabil dan tak linear. Ini membawa kepada pelbagai kajian terhadap algoritma kawalan untuk mengimbangi sistem bandul songsang dalam kedudukan tegak. Secara umumnya, bandul songsang dipasang pada motor DC dan dilengkapi dengan sensor untuk mengukur anjakan sudut. Bandul songsang mempunyai analogi yang sama dengan manusia yang cuba untuk mengimbangi batang penyapu menggunakan hujung jari. Mengimbangi bandul songsang memerlukan sistem kawalan yang baik. Oleh itu, satu teknik kawalan optimum dicadangkan untuk mencapai keperluan reka bentuk yang diingini yang kurang daripada 5% lajakan dan kurang daripada 5 saat penyelesaian masa. Pengawal dioptimumkan untuk mencapai hasil prestasi yang terbaik. Akhirnya prestasi pengawal dibandingkan dengan pengawal PID sebagai penanda aras.

Kata kunci: Bandul songsang, kawalan optimum, tak linear, tidak stabil

INTRODUCTION

Several applications such as attitude control of space booster during takeoff, robot system, bipedal dynamic walking in biomechanics, wheeled motion and balancing transportation system has

the same analogy with inverted pendulum system [1]. This system have a classical problem that has been widely used when multiple test control algorithms which are nonlinear, unstable and non-minimum phase characteristic. These systems also commonly used as a benchmark analyze in many advanced control strategies in order to investigate their advantage and disadvantages.

The main focus in this research is to stabilized around the upright position using state feedback controller. This problem can be solved using optimal controller that would close the open loop system. It will be effective only when then pendulum is near the upright position since the control law is based on linearize point [3]. After optimizing the controller that achieve the desired design requirement as well as has the best trade-off between overshoot and settling time, the performance result is compared with PID controller using same characteristic data input.

INVERTED PENDULUM

It is quite impossible to balance the inverted pendulum without exerting forces on it left and right. Inverted pendulum system normally is unstable in upright position. If there is no exertion force on this inverted pendulum, it can fall down in multiple directions. Besides that the system is nonlinear but it can represent in the state space form by linearize the equations about equilibrium points [2].

Several step need to be conduct to design the optimal controller for Inverted pendulum system. Firstly, the system mathematical modeling need to be determined which involved collection of the physical data of the pendulum. Then the control design is conducted using MATLAB and mathematical software. Simulation is done in Matlab/Simulink software before real time experiment is conducted using Math Works Micro-Box apparatus [4].

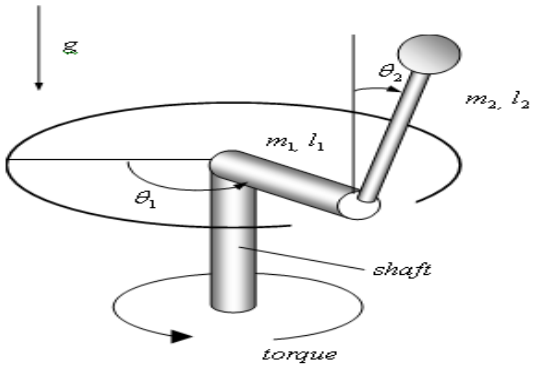

Fig. 1: Inverted pendulum system illustration

$\theta 1$: angular displacement$\theta 1$: angular displacement ;

$\dot{\theta}\dot{\theta}1$: angular velocity of arm

$\theta 2\theta 2$: angular displacement of pendulum;

$\dot{\theta}\dot{\theta}2$: angular velocity of pendulum

$\tau\ \tau$: applied torque

In this experiment, the physical data of pendulum are tabulated in Table 1:-

Table 1: Physical parameters of inverted pendulum system

Physical Quantity	Symbol	Numerical Value
Mass of arm	m1	0.056kg
Length of arm	L1	0.16m
Distance to arm center of mass	C1	0.08m
Inertia of arm	J1	0.00215058 kg-m^2
Mass of pendulum	m2	0.022kg
Length of pendulum	L2	0.16m
Distance to pendulum center of mass	C2	0.08m
Inertia of pendulum	J2	0.00018733 kg-m^2
Armature resistance	R	2.5604 ohm
Back-emf constant	Kb	0.01826 V-s/rad
Torque constant	Kt	0.01826 N-m/A

Based on the mathematical modeling of the inverted pendulum system, the state space representation are[5]:-

$$\dot{x}_1 = x_3$$

$$\dot{x}_2 = x_4$$

$$\dot{x}_3 = \frac{(m_2c_2^2 + J_1)\frac{k_t}{R_m}u - m_2^2c_2^2l_1gx_2 - (m_2c_2^2 + J_2)\frac{k_bk_t}{R_m}x_3}{(m_1l_1^2 + J_1)(m_2c_2^2 + J_2) - m_2^2l_1^2c_2^2}$$

$$\dot{x}_4 = \frac{-m_2l_1c_2\frac{k_t}{R_m}u + (m_2l_1^2 + J_1)m_2c_2gx_2 + m_2l_1c_2\frac{k_bk_t}{R_m}x_3}{(m_1l_1^2 + J_1)(m_2c_2^2 + J_2) - m_2^2l_1^2c_2^2}$$

By substituting the physical parameters, the value of state space representation can be obtained as:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\\ \dot{x}_4\end{bmatrix} = \begin{bmatrix}0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ 0 & -7.1247 & -0.0963 & 0\\ 0 & 59.3267 & 0.0741 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\\ x_4\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 7.0002\\ -5.3847\end{bmatrix} e \qquad y = \begin{bmatrix}0 & 1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\\ x_4\end{bmatrix}.$$

From state space representation, the matrix A, B and C are represented as:

$$A = \begin{matrix}0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ 0 & -7.1247 & -0.0963 & 0\\ 0 & 59.3267 & 0.0741 & 0\end{matrix} \qquad B = \begin{matrix}0\\ 0\\ 7.0002\\ -5.3847\end{matrix} \qquad C = \begin{matrix}0 & 1 & 0 & 0\end{matrix}$$

CONTROLLER DESIGN

Firstly, Riccati equation is used to determine value P and Q in MATLAB command.

$$A^T + PA - PBR^{-1}B^TP + QA^T + PA - PBR^{-1}B^TP + Q$$

After obtaining the value of matrix P and Q, the matrix Q is manipulated to obtain the best results. The value of the matrix Q and the gain feedback as well as the overshoot (Os) and settling time(Ts) are tabulated in Table 2. The Simulink block diagram is represented in Fig.2. Note that the values highlight in yellow is found to be the four value Q matrix that produces the best performance result in term of overshoot and settling time[11][12].

Table 2: The value of matrix Q and its gain value.

No	Value Q [Matrix]	Value of K	Os (%)	Ts (sec)
1	[0 0 0 0; 0 1 0 0; 0 0 0 0; 0 0 0 0]	(-1.0000 -37.7486 -0.8881 -4.8146)	1.3	5.9
2	[100 0 0 0; 0 50 0 0; 0 0 20 0; 0 0 0 1]	(-10.0000 -138.9874 -7.5360 -18.8040)	0.2	4.7
3	[50 0 0 0; 0 20 0 0; 0 0 10 0; 0 0 0 1]	(-7.0711 -106.3415 -5.4239 -14.3748)	0.28	4.5
4	[1 0 0 0; 0 0 0 0; 0 0 1 0; 0 0 0 0]	(-1.0000 -45.8113 -1.4262 -6.1029)	0.6	5.5
5	[50 0 0 0; 0 100 0 0; 0 0 10 0; 0 0 0 10]	(-7.0711 -110.1619 -5.4948 -15.1448)	0.27	4.6
6	[50 0 0 0; 0 10 0 0; 0 0 100 0; 0 0 0 1]	(-7.0711 -232.2561 -12.0438 -31.5259)	0.1	9.8
7	[1 0 0 0; 0 10 0 0; 0 0 100 0; 0 0 0 50]	(-1.0000 -220.2587 -10.3085 -30.7002)	0.02	9.1
8	[1 0 0 0; 0 10 0 0; 0 0 1 0; 0 0 0 0]	(-1.0000 -46.0016 -1.4281 -6.1137)	0.59	5.7
9	[1 0 0 0; 0 10 0 0; 0 0 1 0; 0 0 0 1]	(-1.0000 -46.4305 -1.4324 -6.2528)	0.59	6.1
10	[1 0 0 0; 0 1 0 0; 0 0 10 0; 0 0 0 50]	(-1.0000 -95.3114 -3.5365 -14.6661)	0.1	6.8

RESULT AND DISCUSSION

Simulation Result

The gain values K is substituted in gain block of the state feedback controller in Fig.2 to achieve the result of overshoot and settling time in Table 2[8][9].

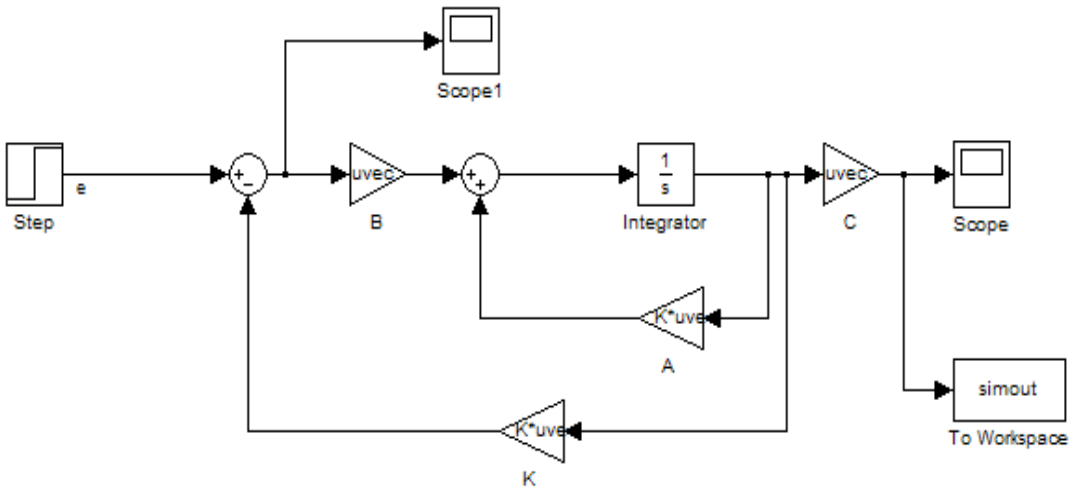

Fig. 2: Simulink block diagram for simulation

The simulation output results are represented in Fig.3:

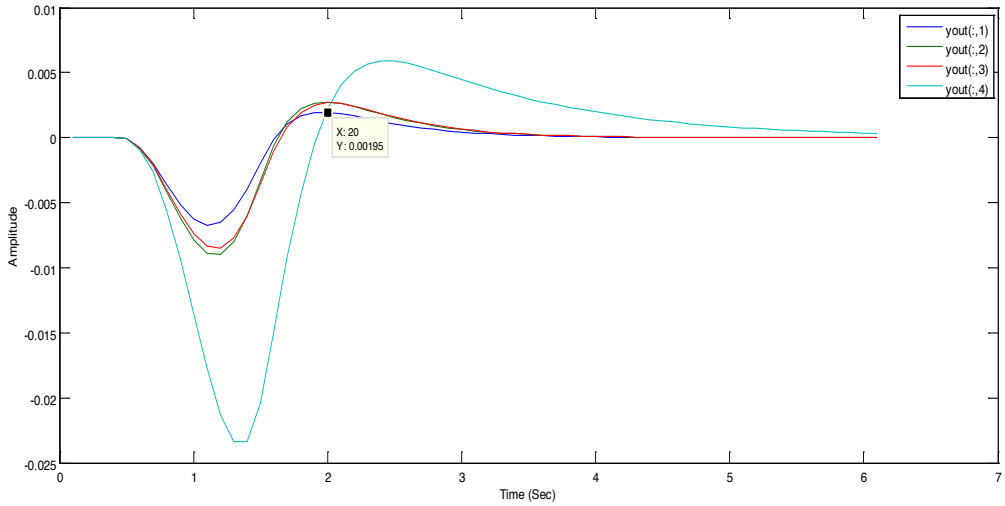

Fig. 3: Simulation output result

Fig. 3 shows the four selected value K value, and the colors represent is blue value of K (2), green value of K (3), red value of K (5) and light blue value of K (8). Result for four selected value is shown in Table 3.

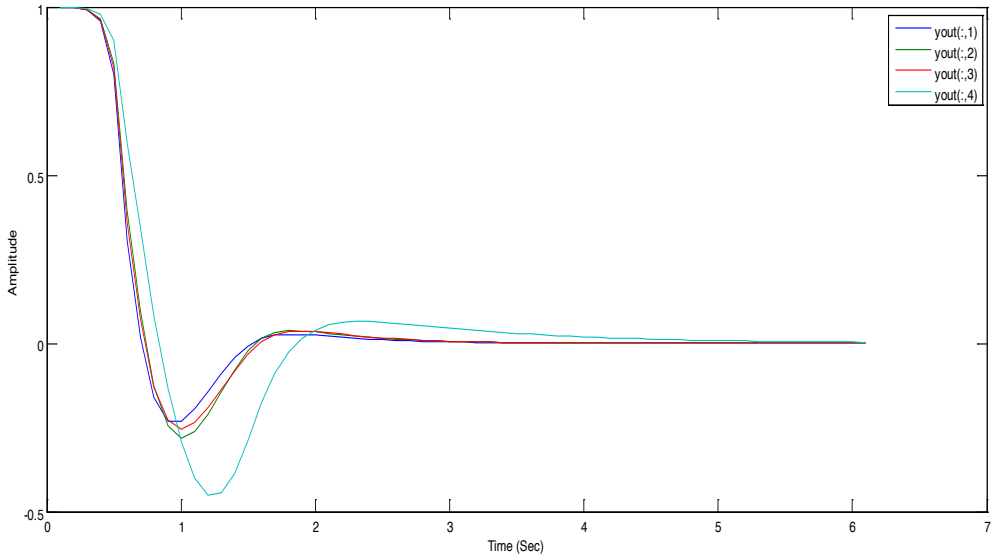

Fig. 4: Control input energy

Figure 4 shows the control input energy of the system. It shows that the value input for K (2) has the most minimize input energy compare with other value of K. Despite of observing the output, the control input energy also needs to be minimize in order to design and optimal control.

Experiment result

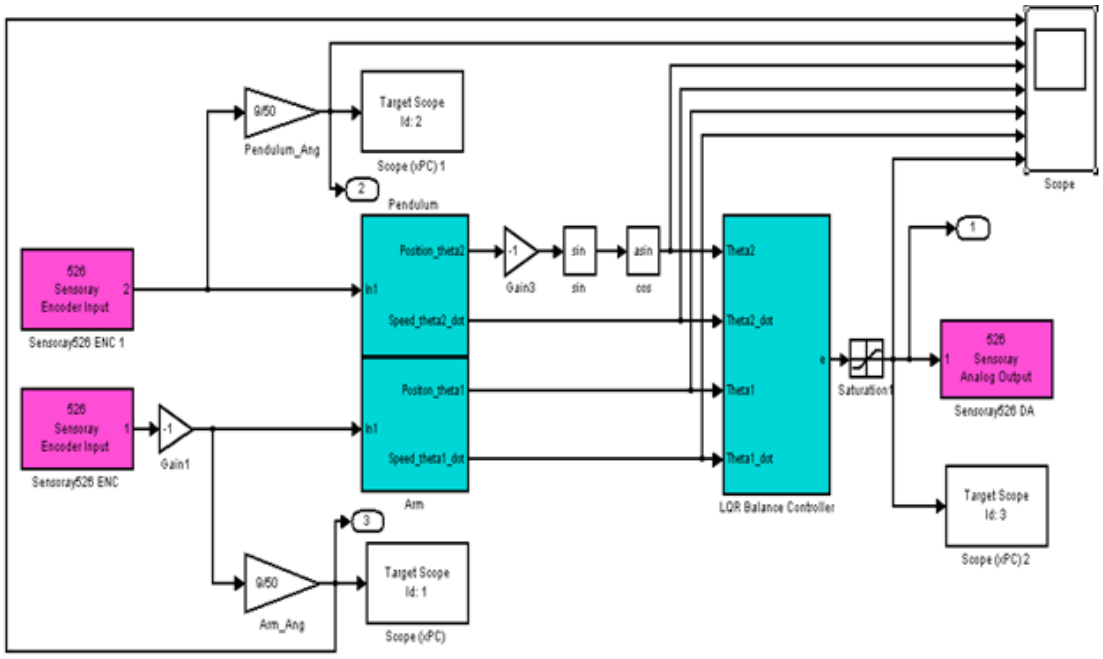

Fig.5.Simulink block diagram for real time experiment

Fig.5 shows the balancing control of rotary inverted pendulum system. It has two input encoder sensor, one for pendulum angle and another one for arm angle. Each encoder has its own gain to control input [6][7]. The gain is set at value 9/50 to multiply input by a constant value (Gain). Another encoders is connected to gain transfer function flow. Gain 3 is set '-1', next SIN and COS for position theta 2, it also for constant input from position theta. Other just goes to LQR Balance Controller which is have Theta 2, Theta2_dot, Theta1, Theta1_dot.Using scope to determine the output result.

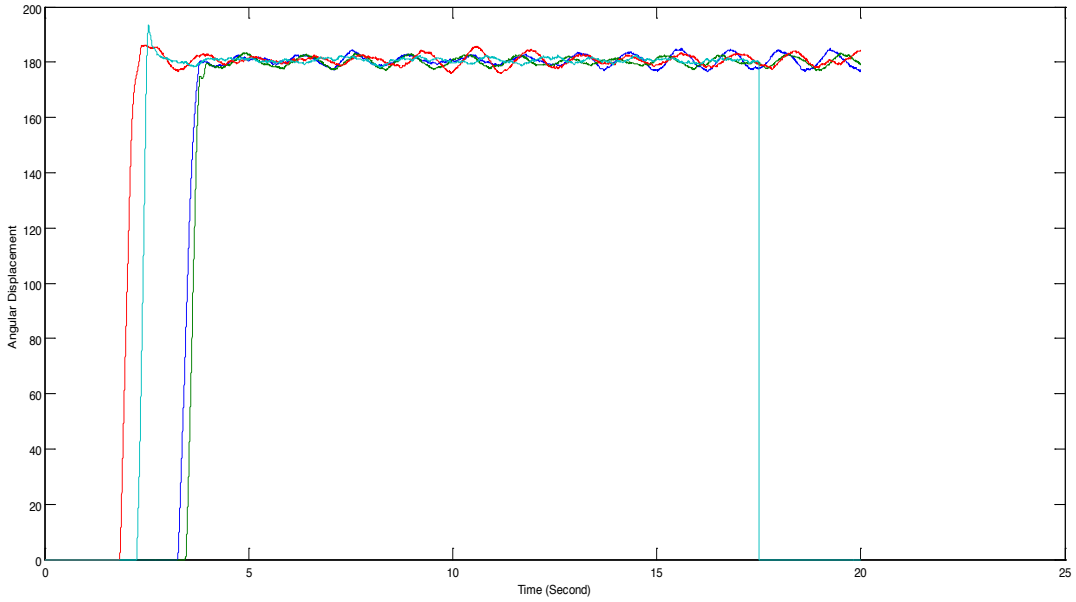

Fig. 6: Experiment output result

From Fig.6, the graph shows that there is no significant difference in term of settling time result. The obvious difference is in term of overshoot result. It can be seen that the four gain values which produces overshoot results which are at K (2) = 1.5%, K (3) = 1.9%, K (5) = 3.4%, and finally K (8) = 7.4%. The overshoot results are taken after the pendulum start stable in first second and before force are applied to it. Overall result for both simulation and experiment is shown in Table 3.

Table 3: Simulation and experiment output result

Value (K)	Simulation		Experiment	Overall
Q	Os (%)	Ts (Sec)	Os (%)	
2	0.2	4.7	1.5	Best
3	0.28	4.5	1.9	Medium
5	0.27	4.6	3.4	Balance
8	0.59	5.7	7.4	Worst

Comparison with PID Controller

Eventually, the performance of the controller is compared with PID Controller. PID controller is a well-known controller and it is commonly used in industrial application. It is also use as a benchmark for this research [10]. PID controller blocks diagram as shown in Fig.7 use PID auto tuner to determine the best result for settling time and overshoot.

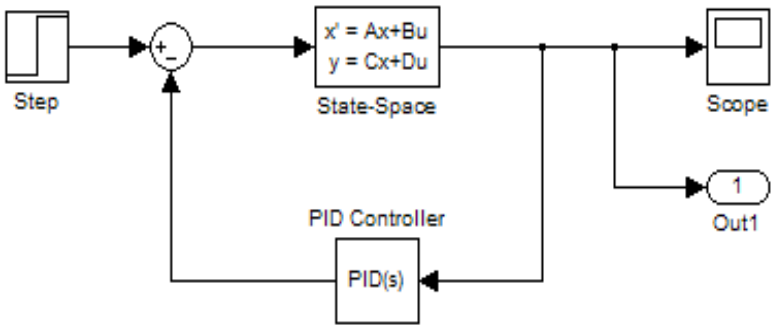

Fig. 7. Simulink block diagram for PID controller(simulation)

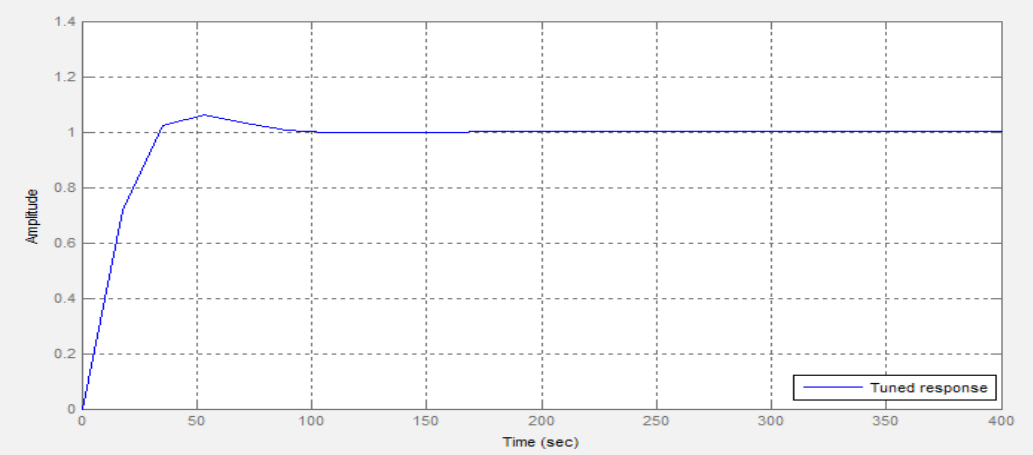

Fig. 8: Simulation output result of PID controller

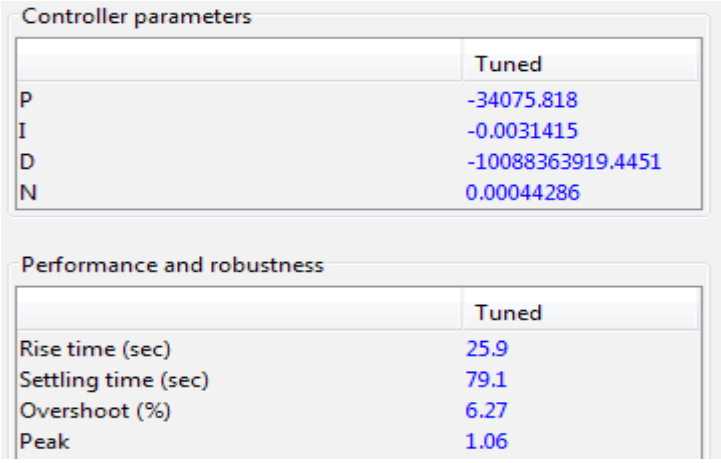

Fig. 9: The result for overshoot and settling time

Fig.8 and 9 shows the simulation output result of the PID controller. The settling time is 79.1 seconds and the overshoot is 6.27%. The comparison with the optimal controller is shown in Table 4.

Table 4: Comparison between optimal and PID controller

	Optimal Controller				**PID Controller**		
Value (K)	**Simulation**		**Experiment**	**Condition**	**Simulation**		**Condition**
Q	OS (%)	Ts (Sec)	OS (%)		OS (%)	Ts (Sec)	
2	0.2	4.7	1.5	Best	6.27	79.1	Worst

Table 4 summarizes the overall result of the research. It shows that the optimal controller produce a better result than PID controller particularly based on simulation result. The controller achieves the desired design requirements which are less than 5% overshoot and less than 5 seconds settling time.

CONCLUSION

This research has successfully meet the objective to design a controller for rotary inverted pendulum system that has the best trade-off between settling time and overshoots as well as achieves the desired design requirement. It has been verified via simulation and experimental test. Besides that the controller also produces a better performance than PID controller based on simulation test.

For future studies, it is recommended to design a complete mechanism of inverted pendulum system by including the design of swing up controller. The pendulum may be started from a normal vertical downwards position and then by applying swing up controller, it swing until reaches a certain point where it switch to the balancing controller. Besides that, in order to obtain a more precise result, a experiment for PID controller also need to be conducted in the near future. The controller also can be further applied in a larger application such as balancing robot and transportation.

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M.A.H.M.Nazri
Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
Mizlhakim@yahoo.com.my(06-5552331)

M. H. Jali
Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
Mizlhakim@yahoo.com.my(06-5552331)
mohd.hafiz@utem.edu.my(06-5552331)

H. Sarkawi
Faculty of Electronics and Computer Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
[c]hafez@utem.edu.my(06-5552112)

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A Review of Finite Element Method in Detecting Incipient Faults Occur in Power Transformer

Nor Azizah Mohd Yusoff, Kasrul Abdul Karim & Sharin Ab Ghani

ABSTRACT

As one of the particular parts in power system, power transformer needs aserious attention. The responsibility and set up in planning preventive maintenance of transformer is important for ease of restructuring power system diagnosis. Inter-turn short circuit cases are the major fault that drives into severe failures in power transformer. To this end, Finite Element Method (FEM) has been proved to be a potential tool for analyzing the physical behavior of real transformer in the presence of inter-turn faults. This contribution is aimed at obtaining diagnosis throughout justifyingthe modification of winding frequency response as a result of fault occurrence. Finally, this paper reviews an experimental work by Frequency Response Analysis (FRA) to validate the FEM of the faulty transformer simulation. The result of the experiment is capable to demonstrate the model from FEM to reproduce the real behavior of the transformer with inter-turn winding faults. This may be possibly beneficial for a few jobs which from the illustration of FEM result; it was yield insight into developing several patterns of failures in fault detection of power transformer.

Keywords: Power Transformer, Fault failure, FEM, FRA.

ABSTRAK

Sebagaisalah satu daripada bahagian-bahagian tertentu dalam sistem kuasa, kuasa pengubah yang serius. Tanggungjawab dalam perancangan penyelenggaraan serta pencegahan pengubah adalah penting untuk memudahkan penyusunan semula sistem kuasa diagnosis Keslitarpintas antara penggulungan adalah kerosakan utama yang mendorong kepada beberapa kegagalan teruk dalam pengubahkuasa.Untuk tujuan ini, kaedah unsur terhingga telah terbukti menjadi kaedah yang berpotensi untuk menganalisis tingkah laku fizikal pengubah dengan kehadiran litarpintas ini Sumbangan ini adalah bertujuan untuk mendapatkan diagnosis melalui pembuktian dalam respon kekerapan terhadap perubahan penggulungan akibat dari kerosakan. Akhir sekali, kertas kerja ini turut mengkaji respon analisis kekerapan melalui eksperimen untuk mengesahkan kaedah simulasi unsur terhingga bagi pengubah kuasa dalam keadaan kero akan. Hasil daripada eksperimen mampu menunjukkan model daripada kaedah unsur terhingga dapat menghasilkan tingkah laku sebenar pengubah akibat kerosakan antara penggulungan. Ini mungkin bermanfaat untuk beberapa pekerjaan yang mana dari contoh keputusan kaedah unsur terhinggaakan memberi wawasan dalam menghasilkan beberapa corak kegagalan untuk pengesanan kerosakan kuasa pengubah.

Kata kunci- Pengubahkuasa, Kegagalankerosakan, FEM, FRA.

INTRODUCTION

Power transformer roles the most important part in substation lines, thus most expensive components of power system in between. However a transformer is said to being fail when it is forced by any circumstances that often result inability to functioning properly under normal condition system.Majority of these devices have been exposed through fault under environmental, electrical and mechanical events.The faults impact may causes a huge blackout that plunged half of area into darkness and thousand of connecticut light with power customer loss. Moreover, it causes financial effect as almost of business crucially run by electricity. Despite of that, the record showsalmost 80 percent of power failure causes by short-circuit between transformer turns [1] which contribute to massive losses in terms ofpower transmission as well as expensiveness.
Short circuit occurs when two lines or if the neautral point is earthed between any one lines established by accidents. Through this occurs, the electricity will essentially jump to a part of the circuit which it is not supposed to and possibly cause damage. Once a fault is established, it will continue until the ionized path is interrupted, the circuit is turned off, or something burns down. This phenomena will produces high current andexaggeratethe internal forces inside of winding transformer.

SHORT CIRCUIT IN WINDINGS

The incipient fault or internal fault of short circuit is a common symptoms that are nothing more than continually interrupting of transformer activity. Generally well known that resulting from this phenomena the temperature of transformer will be high or lead to instability of ouput volatge. Aside from that, short circuit in transformer can be seen into three basic categories as show in figure 1, which is devided in winding-to-ground (1, 8, 4), winding-to-winding (2, 5) and winding inter-turn fault (3,7,6).

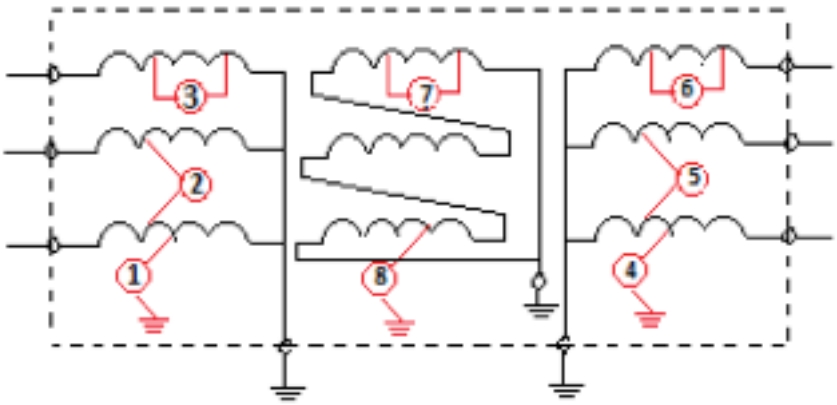

Fig 1: Schematic of internal fault [3]

To maintain a high level of focus, this paper will review on inter-turn fault as this fault act as one of the leading root causes of failure in power transformer. An inter-turn fault occur because of deterioration in turn insulation and constitute breakdown between turns at the same phase winding. This mightbe due to frequent transformer overloading, mechanical vibration, high

transient voltage stresses, high current stresses particularly in the presence of external short circuits, thermal overloading and contimination [2].

The fault current is relatively large and cause significant damage if not detected and isolate rapidly. In early stages of winding inter-turn fault might be have negligible effects but this nature of interturn fault against transformer will lead to sequential of mechanical and thermal faults problems. Figure 2 presents how this faults is being interact to each other resulting from high over-current condition thus allow us typically challenging and the difficulty to analyze the fault location.

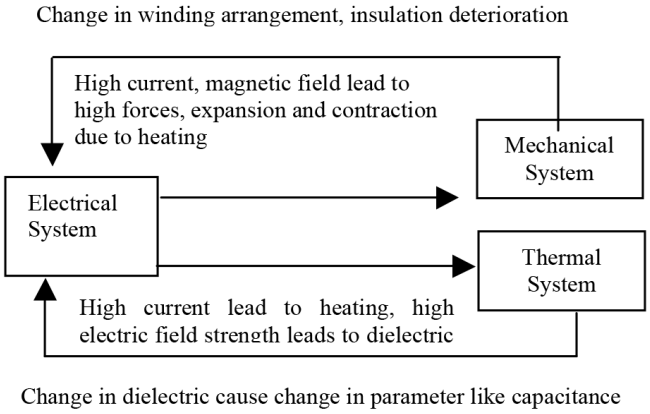

Fig 2: Overview Interaction Fault analysis [4]

Once the inter-turn fault extract to winding, the short-circuit strenght of a transformer enables it to survive through high fault current due to external short-circuit in a power system network; an inadequate strength may lead to mechanical collapse of winding deformation damage to clamping structure, any may eventually lead to an electrical fault in the transformer itself [5]. Insight of thermal analysis part, the turns insulation of transformer is damage when the essence of heat generated by high fault current yeild to dielectric breakdown phenomena. Indirectly, it causes the changes in a parameter of capacitance and its characteristic significant to the changes of thickness for dielectric. Therefore, diagnosis for turn insulation is beneficial to cut down electric failure which cause a million of damage and many often fatal, injuries every year.

SEVERAL TYPES OF TRANSFORMER FAULT

Although the actual cause of the failure of transformer could be found from short circuit, other miscellaneous failures from side of electrical effects is harmonics current which produce from non-linear load. As example of this is when harmonic currents are flowing in transformer immediately generate extra heat in the transformer windings and core laminations. Losses from high-frequency of eddy currents constitute the primary cause of this extra heat. Some additional harmonic heating is due to skin effect, where the effective cross-section of a conductor reduced at high harmonic frequencies. The amount of harmonic heating a transformer can tolerate is inversely proportional to the total secondary load.

A heavily loaded transformer can overheat and fail if a large portion of the load current contains harmonics. Then, the second major fault in transformer may have resulted from

mechanical fault. For instance is tap changer failure. This is affecting from malfunction of the mechanical switching mechanism or from high resistance load contacts. Otherwise, transformer bushing able give rise to failure in transformer probably by general aging, contamination, cracking or loss of oil. Hence the transformer failures may have more than one determinant factor. Some of the common factors from element of electrical, mechanical and thermal can be categorized in table 1.

Table 1: Factors of transformer failure

	Factor
Electrically Induces	- Operation of a transformer under transient or sustained over-voltage condition. -Exposure to lighting surges and switching surges. - Partial Discharge - Static electrification
Mechanically Induces	- Hoop (inward radial) buckling of the innermost winding - Conductor tipping - Conductor telecosping - Spiral tighttening - Failure of the coil clamping system - Displacement of a transformer's incoming and outgoing leads
Thermal Induces	- Overloading - Failure of cooling system - Blokage of axial oildust spaces - Operating in overexcited condition - Operation under excesessive ambient temparature condition

DIAGNOSTIC TESTING

Therefore continual advancemants in transformer diagnosis is usefull for tracking this fault despite to provide information in maintenance management system for transformer. According to table 2as can be seen on one type of fault is consequence from many causes. Therefore, this table consist checklist for suggested electrical test.

FINITE ELEMENT METHOD

The propose technique to be approach in this paper is a Finite Element Method. The main advantage of FEM, this software engineering is typically associated with the magnetic potential and electrical distribution in non-structural problem because of its ability to model the transformer in geomatrically. Its good for approximation for analyze instead to design of an actual transformer model either in 3-D or 2-D design. The literature in paper [6] describes the analysis of short circuit using Finite Element Method under software monitoring. Through this method the electromagnetic forces acting on each section of winding can be calculated under short circuit condition. Thus, the inter-turn fault is imposed to the model of transformer in the FEM simulation program in order to investigate the transcient behavior of the transformer at typical faults in a real power supply.

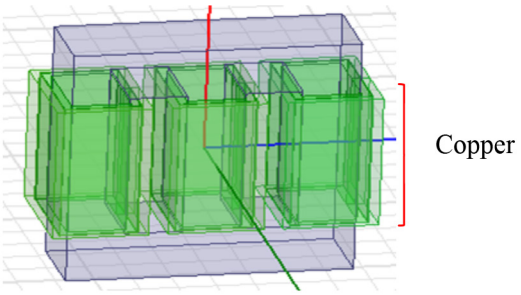

Fig 3: Geometry of 3-D FEM Model

TRANSFORMER MODELLING BY FEM

Generally speaking, method in FEM is effective and expert system as designing tools rather than analysis method. On top of that, software of Finite Element Analysis has been pioneers in design the transformer-model that yields into analyze the effect of inter-turn fault. Simulation by Finite Element was carried out according to the specification of the real core-type transformer with rated 350 VA. The design data were as follow:

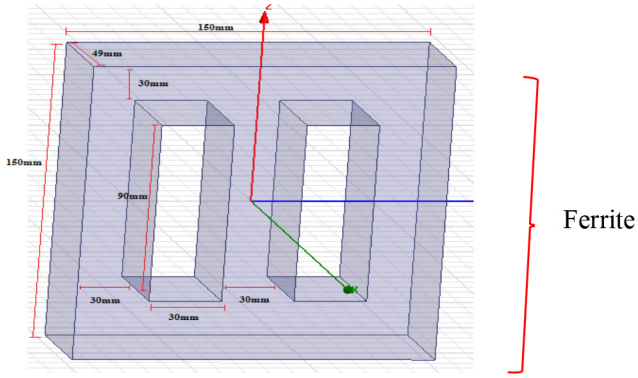

Fig 4: Core dimension for the 350VA transformer

STEP FOR ANALYZING MODEL

After complete the initial setup like to define the material and unit by finite element it involves to several stages which it is consist of the excitation towards the model. Thus it could probably a general sources like from Maxwell equation (current for magnetic fields and charge or voltage for electric field).

The next step in finite element is consisting for specified the boundary condition. The boundary condition will enable to control the characteristic of plane, faces or interfaces between the object. Then in a certain cases any users can require the excessive mesh operation for their analyzing. It because to over define the mesh will take longer to solve, and will be more difficult to adopt correctly [10]. Finally in last stages, all procedure will be analyzed with all the analysis setup and all optometric setup within the active design. Significant by having every necessary part or element in FEM, the complex variation of fault can be analyzed especially the critical fault in power transformer.

FEM OF FAULTY TRANSFORMER

After all the information is gathered, an in-depth analysis of the failure scenario in transformer will allow the researchers to offer a better ways in detecting the fault location. Referring to [11] in the case of inter-turn fault, the fault of 4A is initiated across 4 turns through resistance to limit the fault current. As we can see in figure below is show the differential between healthy and faulty conditions that obtained from FE analysis. It can be observed from this figure is the magnetic field density (H AT/m) in H-plot.

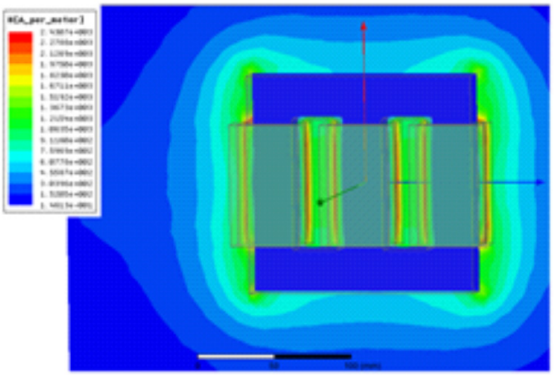

Fig 5: Geometry of Healthy FEM Model

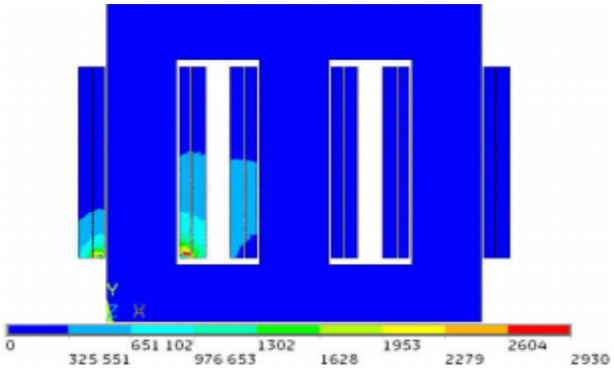

Fig 6: Inter-turn fault FEM Model [11]

EXPERIMENTALVALIDATION

The result from measurement through experimental work and simulation are being compared to validate the Finite Element model through simulation. This result can give some insight into the analysis in future work. Reference [7] presented a diagnosis of power transformer in core fault under experimental work using Frequency Response Analysis (FRA).

B. FREQUENCY RESPONSE ANALYSIS

The FRA technique measure the admittance or transfer function over a wide range of frequency in transformer which allow us to know the internal state of fault in the machine [8]. The differences between the results may indicate to the damage inside of the transformer when the impedance was reflected to the frequency response.

Table 2: Types of Electrical test in transformer diagnosis

		Prescribes of Diagnosis Fault Test							
Fault	Causes	Oil test	Turn ratio	Power factor	Insulation Resistance	Winding resistance	Exciting Current	Induces voltage	*FRA
Turn to turn	• Winding Short circuit								
	• Winding open circuit	X	X			X	X	X	X
	• Winding distortion or displacement								
Open Winding	• Floating metal particles	X	X			X			
Majoring Damage (Phase to ground)	• Winding Short Circuit						X	X	X
	• Loose collars, spacers, core ground straps, core hold down angle.	X		X	X				
	• Free water or excessive moisture in oil	X							
High moisture level	• Damaged shunt packs of tanks	X		X	X				
	• Cooling system malfunction								
	• Jammed oil circulating path								
Mechanical Damage	• Loose connection to bushing terminals	X							X
	• Overloading								
	• Damaged yoke bolt insulation								
Core Overheating	• Rust or other damage on core	X			X		X		

*FRA: Frequency Response Analysis

The response in FRA can be categorized in three frequencies ranges which are low- frequencies, medium- frequencies and also high- frequencies response. These three ranges of frequencies are useful for us to develop a pattern of fault in power transformer due to different frequencies response in FRA. For example, under short circuit condition, magnetizing characteristic of the core are changed indirectly change low-frequencies response in FRA. Then, medium-frequency responses will reveal changes when mechanical movement between winding are detected whereby consider to radial phenomena. However, the damaged of the winding such as axial deformation

can be localized by concerning to the change of high-frequencies response. Owing to its popularity, thus, the inter-turn faults may be respectively to low- and high-frequencies response in FRA. Recently method that responsible to carry out of FRA measurement is a Swept Frequency Analysis (SFRA). This method involves when a sinusoidal voltage was injected into one end of winding and the output current is measure at the end. S.Ab Ghani has describes three different technique in order to interpret of SFRA result in his paper [12]. Below the technique in this paper there have been show significant advance in the analytical calculation and statistical evaluation in order to analyzes different types of fault in power transformer. Figure 7 and 8 representation the illustration of SFRA concept, including recorded waveform that show the located of fault.

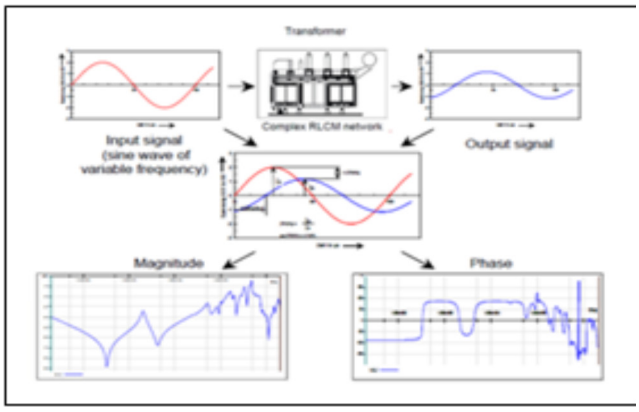

Fig 7: Concept of SFRA Measurement [12]

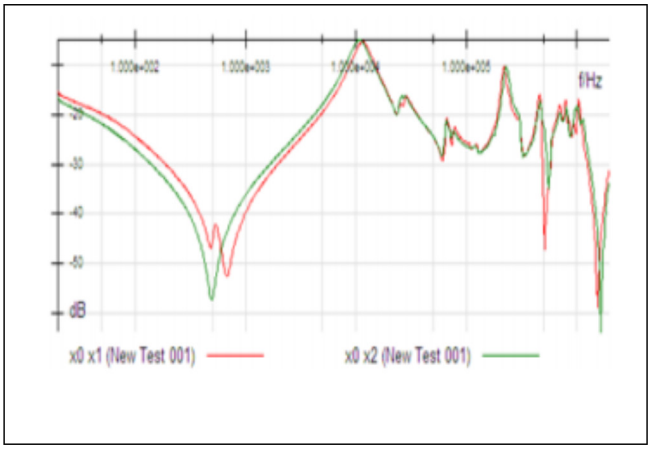

Fig 8: Result of SFRA Measurement[12]

Tenbohlen and Ryder [9] have explored the relative advantages and limitation of this method which are summarized below.

i. Advantages Of Sfra Method
- High signal to noise ratio.
- Wide Frequency Range
- Adaptable frequency increment (better resolution at low frequencies.

- Only one piece of measuring equipment needed (Network Analyzer)
- Intuitive and straight forward.

ii. Disadvantages of Sfra Method:
- The time taken to do each measurement is relatively long.

Thus through comparison of the result from the simulation and experimental test is capable to demonstrates the remarkable ability of the FEM software in order to reproduce real behaviour of transformer in healthy and faulty conditions.

CONCLUSION

The contribution in this paper presents a review of diagnosis system through software monitoring by Finite Element Model in the presence of winding inter-turn fault. The same model transformer is used either in experimental or simulation part. The significant of this is to appeal the result from both of this method. The similarity of result will demonstrate the capability of FEM to reproduce the complex physical behavior of the transformer either in healthy or faulty condition. Hence, by achieving the whole variety of test of fault will produce a clear pattern in the electromagnetic characteristic of the transformer damaged by the inter-turn fault [13]. Thus this software probably to display some of pattern for variety faults in power transformer.

Indirectly, it allows engineers for making short-term decision regarding to patterns from FEM result in variety of fault. Example: one of the actions can be taken is by reducing the load on transformer. Otherwise the summary for other faults that identify appear in power transformer is present in table 2 with their several methods for monitoring and diagnostic as reference. The in depth analysis of power transformer from researchers nowadays will having the potential to develop advanced technology in diagnosis transformer.

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Learning and Manipulating Human's Fingertip Bending Data for Sign Language Translationusing Pca-Bmu Classifier

Nazrul H. Adnan, Khairunizam Wan, Shahriman Ab,
Juliana A. Abu Bakar, Azri A. Aziz & M. Hazwan Ali

Abstract

Nowadays the classification of fingers movement could be used to classify or categorize many kinds of human finger motions including the classification of sign language for verbal communication. Principal Component Analysis (PCA) is one of classical method that capable to be verity the finger motions for various alphabets by reducing the dimensional dataset of finger movements. The objective of this paper is to analyze the human finger motions / movements between thumbs, index and middle fingers while bending the fingers using PCA-BMU based techniques. The used of low cost DataGlove "GloveMAP" which is based on fingers adapted postural movement (or EigenFingers) of the principal component was applied in order to translate the finger bending to the sign language alphabets. Preliminary experimental results have shown that the "GloveMAP" DataGlove capable to measure several human Degree of Freedom (DoF), by "translating" them into a virtual commands for the interaction in the virtual world.

Keywords:EigenFingers; finger movement classification; hand finger bending; Human-Computer Interaction; Principle Component Analysis (PCA)

Introduction

Many approaches for effective Human-Computer Communication have been proposed such as voice, face and gesture recognition systems. One approach involves the use of special devices, like sensor gloves to translating hand function and finger movement activities for rehabilitation process known as the DataGlove [1]. A commercial DataGloves usually use expensive motion-sensing fibers and motion analyzers are consequently too costly for the consumer market [2]. Nowadays, there are various methods of using sensing technology applications in order to improve the research and development for DataGloves application. For the example, Fahn C.-S et al [3] used the DataGloves that are able to provide the several high accuracy, high reliability, and high capability in measuring the DOF of human hands. Most of them are constructed by using the scientific sensor devices in order to measure the finger bending angles. Oz et al. [4] explained that by using the existing system of a sensory Cyberglove assisted with the ability of Flock of Birds 3-D motion tracker, the resulting system has managed to translate 26 American Sign Language (ASL) alphabets on a very impressive number of extracting gesture rate equally to 96.0% by using the artificial neural network (ANN) approach. Nakada et al. classified hand motion in use of

chopsticks by classification method proposed by Kamakura [5][6]. The advantage of this method is it makes separations of each finger pattern clear. Several researches have proved that there are systematic coordinated motions in the human hand [7]-[10].

The goal of this research is to verify the entire finger bending movement / motion signals that recorded using GloveMAPDataGlove and the performance of data gathered to be determined by Principal Component Analysis (PCA) method. The advantage of this evaluation is not depend on size of human hand even though data are might difference because of difference finger bending style between the user. In this research, the use of PCA will provide groups of classification principle component of the fingers bending.

This research paper is structured as follows: Section 2 addresses the literature review of the related researches to the several approaches, applications and problems of recognizing the fingers bending movement. Section 3 describes the methodologies of the system. Section 4 describes the project experiment. Section 5 describes results and discussions. Finally on section 6 described the conclusions and proposing some possible future work.

Methodologies

The design and the method of bending the objects by using DataGloveGloveMAP were shown in Figure 1. The main prerequisite was to represent the human finger movement / fingertips bending as accurate as possible. All fingers are able to perform the fingertips flexion motions. The bending of thumb, index and middle human finger for several alphabet were well-defined in a marginally due to its special kinematical structure of GloveMAP. Figure 1 shows the low cost DataGlove called as GloveMAP for several finger bending movements activities.

EigenFingers

PCA has been found useful in many applications, such as, data analysis, process monitoring and data rectification [11]. PCA is a dimensionality reduction technique in terms of pick up the variance of the data and it interpretations for correlation among the variable. The coordinates of the new axis is calculated by changing the coordinates of the ordinary data. It is the revolution of linear multispectral space (measurement space) into the space of Eigenfingers (feature spaces). Let the dataset, consisting of p observation variables and q observations for each variable stacked into a matrixit is expressed in equation (1)

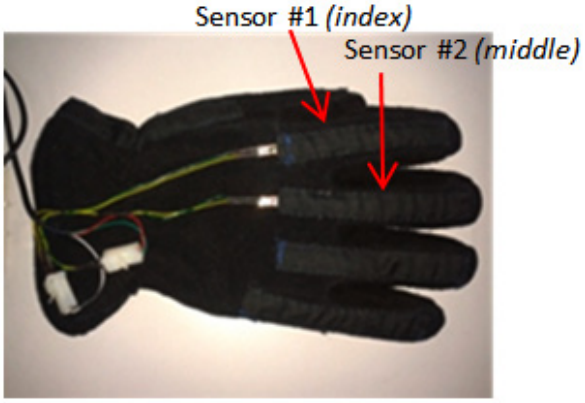

Fig 1: Resistive interface glove (GloveMAP)

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1p} \\ X_{21} & X_{22} & \dots & X_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ X_{q1} & X_{q2} & \dots & X_{pq} \end{bmatrix} \quad (1)$$

The principal component transform is defined by:

$$J = A^T F \quad (2)$$

A is an Eigenfingers matrix with a normalized covariance matrix F. Then J has a diagonal covariance matrix:

$$C_j = AC_X A^T = \begin{bmatrix} \lambda_1 & 0 & \dots & 0 \\ 0 & \lambda_2 & \dots & \dots \\ \vdots & \vdots & \vdots & \vdots \\ 0 & \dots & \dots & \lambda_n \end{bmatrix} \quad ; \text{Where } C_X = \lambda_i t_i \quad A^T A = A^T \quad (3)$$

Meanwhile $\lambda_1\lambda_1 > \lambda_2\lambda_2 \dots > \lambda_n$ are the eigenvalues of the covariance / diagonal covariance matrix of F. Then, to meet the terms of the analysis of PCA the use of Eigenfingers and Eigenvalues are requisite. Whereas Eigenvalues can be simplified as Eigenvalues = Eigenfingers*original data. The analysis can assume to be as a list of real numbers and depending on the concepts of vectors and linear transformations [12]. EigenfingersJ of A and Eigenvalues λ can be determined as:-

$$A_J A_J = \lambda_J \lambda_J \quad (4)$$

Can be simplified as:

$$(A - \lambda I)X = 0(A - \lambda I)X = 0 \quad (5)$$

Where λ and A are calculated using Jacobi method [30], meanwhile I is an identity matrix. By using the equation 11, it is simply find the determinant of the Eigenfingers.

$$\det(A - \lambda I) = 0\det(A - \lambda I) = 0 \quad (6)$$

In particular, the finger bending and fingers bending may reduce the number of features needed for effective data representation by discarding the bending data. Equation 6 shows only small variances and retain only those terms that have large variances [13]. Let $\lambda_1\lambda_1, \dots, \lambda_l\lambda_l$ denote the largest l eigenvalues and associated eigenfingers be denoted by $Q_1Q_1, Q_2Q_2, \dots, Q_xQ_x$ respectively. The equation may write as:-

$$\bar{J} = \sum_{X=1}^{I} A_X Q_X \quad (7)$$

For the calculation of dataset reduction the use of averages and standard deviations are essential for data centering and reduction. $\bar{x}\bar{x}$is the arithmetic mean of each column, it is presented by equation (14). The standard deviation is the square root of the variance; it is presented by equation [14]:

$$\bar{x} = \frac{1}{f}\sum_{i=1}^{f} x_i \tag{8}$$

$$\delta^2 = \frac{1}{f}\sum_{i=1}^{f} (x_1 - \bar{x})^2 \tag{9}$$

Classification of the dataset based on Best Matching Unit (BMU)

The Best Matching Unit training algorithm is based on competitive learning which a particularly same as the neural network supervised learning technique. In this study, the BMU approach is employed to the dataset outputted from PCA, and thus the proposed algorithm is called PCA-BMU. To start the BMU features learning, the first step is to initialize all the neurons weights in the dataset features either to make the grouping values or sampled by the two largest principal component eigenvectors of the training samples. In order to utilize the competitive learning training technique, the sample dataset must be functioning as feeder to the features network by calculating the distances between neurons to their positions with a distance function. Euclidean distances between x and all the prototype vectors are computed, in order to find the best matching neuron unit. The BMU is selected as the unit that is the nearest to the input vector at an iteration t, using equation below:-

$$\|x(t) - w_c(t)\| = min_i \|x(t) - w_i(\quad \|x(t) - w_c(t)\| = min_i \|x(t) - w_i(\tag{10}$$

Once the new BMU is generated then the winning neuron is identifying i* then the "neighborhood" of the winning neuron could be calculated using the Kohonen rule. Specifically, all such neuron $i \quad i \,(\quad i \quad i$ are adjusted as follows:

$$W_i(q+1) = W_i(q) + \Theta(i,q)\alpha(q)(p(q) - W_i(\tag{11}$$

Where α(q) is a monotonically decreasing learning coefficient and p(q) is the input vector. According to [15] stated that the other method to simply determine the best matching unit is using the node justification through all the nodes and the winning nodes could be calculated using the Euclidean distance between each node's weight vector and the current input vector. The node with a weight vector closest to the input vector is tagged as the BMU. Where V is the current input vector and W is the node's weight vector.

$$Dist = \sqrt{\sum_{i=0}^{i=n} (V_1 - W_1)^2} \tag{12}$$

Clustering Analysis

A proficient and effective finger bending feature classifier system often consists of a defined set of feature classes. Feature groups are well separated by a set of features that are typically derived from the multi-dimensional fingertips bending dataset. The most challenging step in clustering the fingers movement was feature extraction or pattern representation. In classification the objects were assigned to pre-defined groups, whereas in clustering the groups were also to be defined. However to achieve the partitioned indifferently for several applications dataset then clustering analysis was the best option. Figure 2 show the steps of finding the finger banding data cluster using principal component analysis (PCA).

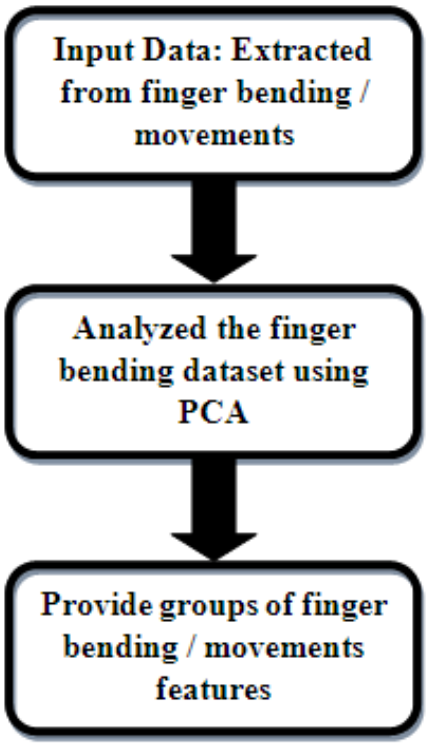

Fig 2: Fingers bending / movement's classification using Principal Component Analysis (PCA)

EXPERIMENTS

The experiment was carried out using real objects manipulated by a GloveMAP. Five people/subjects were needed in doing this experiment for fingers bending. Arrangements of GloveMAP wearer were required to bend their finger according to the alphabet. The chosen of alphabet depends on the diversity of finger bending for every human being was indifferently. According to our previous research [9] [16][17][18] the way of wearing the GloveMAP will lead to the correct grip objects and it has already proved by the classification of finger bending data. Figure 3 shows the sample of fingers movement using the GloveMAP.

During the task tested, each of the subjects must wear the GloveMAP on the right hand. All of the sensor values of the glove were sent through MATLAB engine into MATLAB®SIMULINK where all the dataset were transformed into data coordinates. The number of data configurations was determined accordingly to the bending duration for each group. It may seem trivial at first sight, since one could just fix a maximum number of data and divide it by the number of groups. For this research, we propose

not to justify a maximum number of samples, but some reasonable number of samples per bending activities.

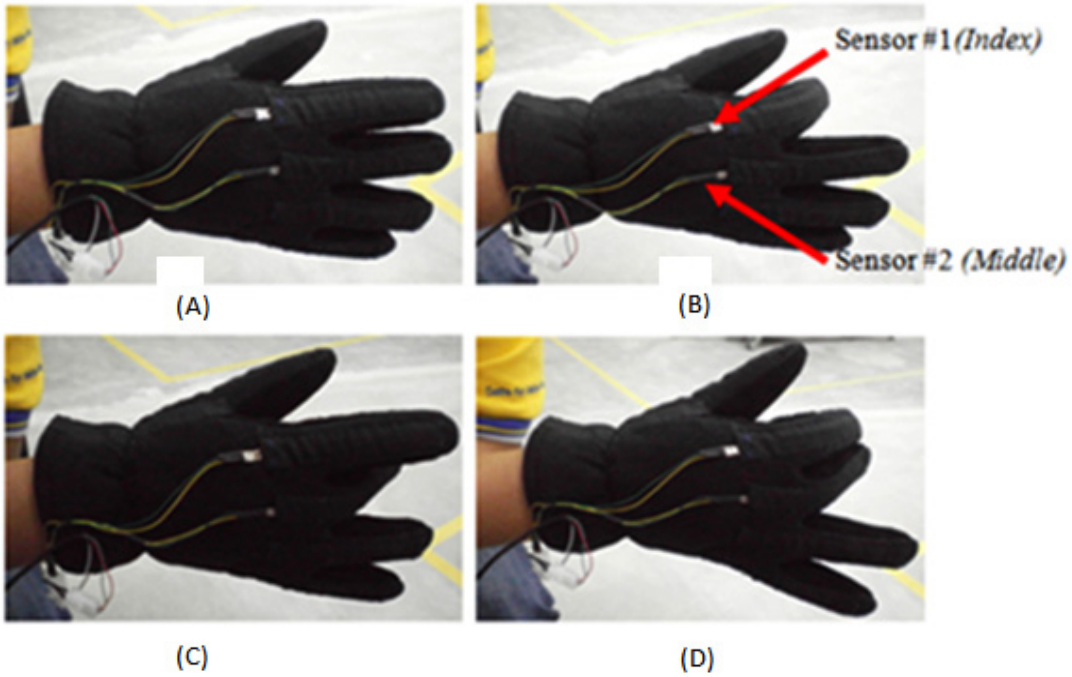

Fig 3: The example of GloveMAP finger movement activities (A) straighten fingers (B) bending of index finger (C) bending of middle finger (D) bending of both fingers [16][17]

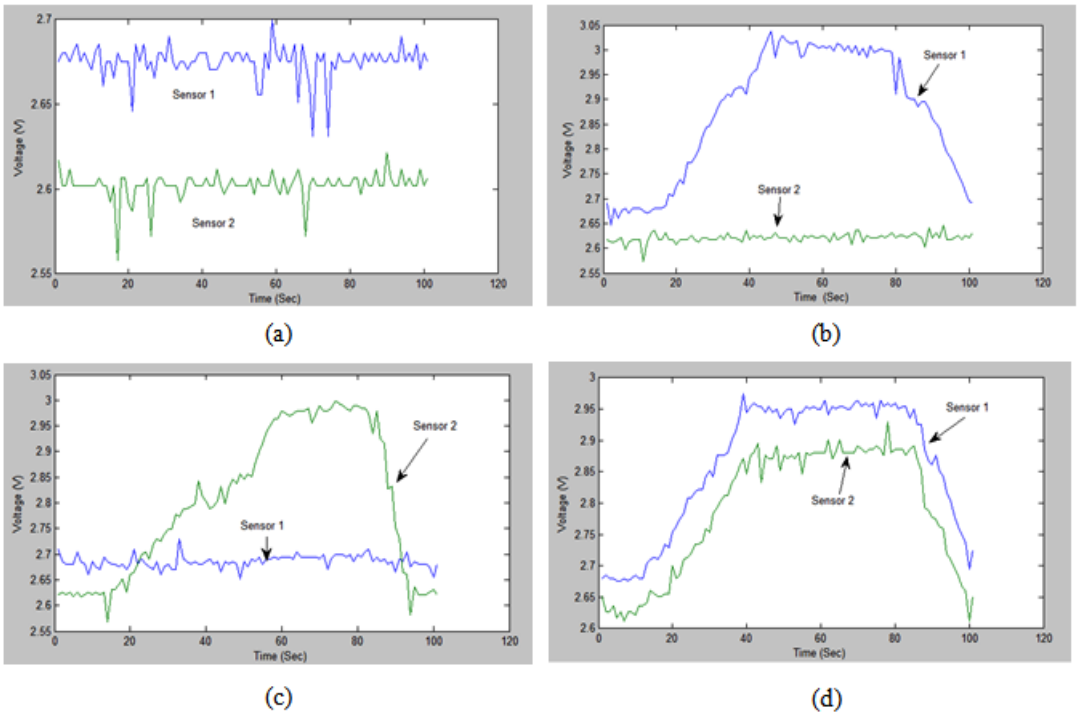

Fig 4: Finger activities (a) straighten fingers (b) bending of index finger (c) bending of middle finger (d) bending of both fingers

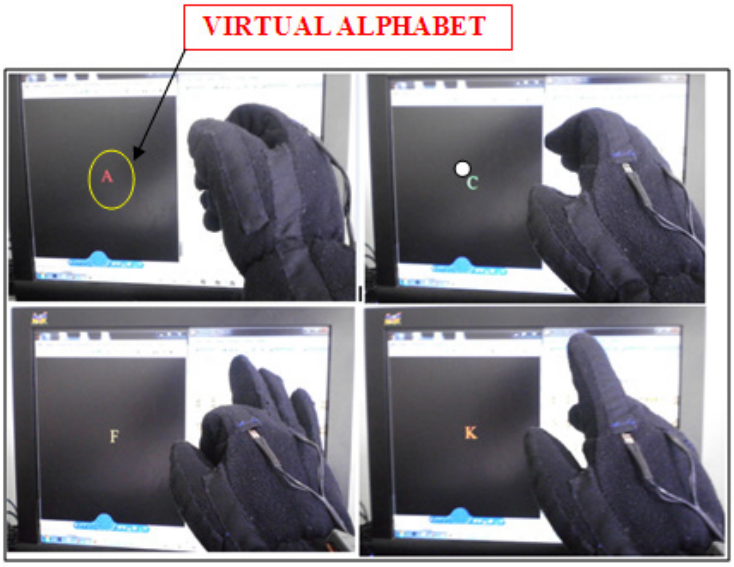

Fig 5: Interaction with virtual interaction

RESULTS AND DISCUSSIONS

For the experimental result, fig. 5 shows several activities of the fingers motion have been taken. Finger bending process is intended to provide an appropriate signal to the microprocessor then the signal from the Arduino transmitting directly to the virtual program that can make it translating the virtual alphabet stored in the computer. Then the use of PCA clustering for simplest approach to reduce the impact of a large number of classes on the PCA-based fingertips bending recognition method is needed. Data's were manipulated using the MATLAB®SIMULINK in order to overcome the correlation between the fingers movement data of principal components by the DataGlove "GloveMAP". Research on the sequential learning has proven that clustering results in the training data set can enhance the generalization ability in fingers clustering. Figure 6 shows all the data's will be going to be analyzed using Principal Component Analysis (PCA) methods whereas the data are taken directly from GloveMAP fingertips bending. After that all the data will be going to be analyzed using MATLAB®SIMULINK for principal component processing (EigenFinger) for feature extraction and dimension reduction as shown on the Fig. 7.

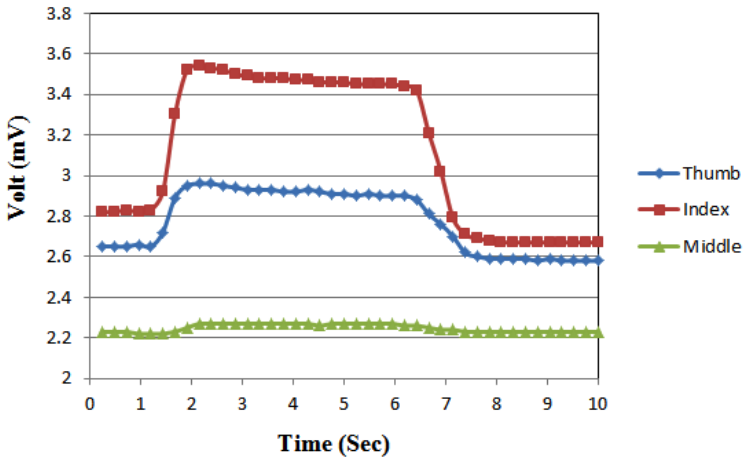

Fig 6: The initial finger bending data

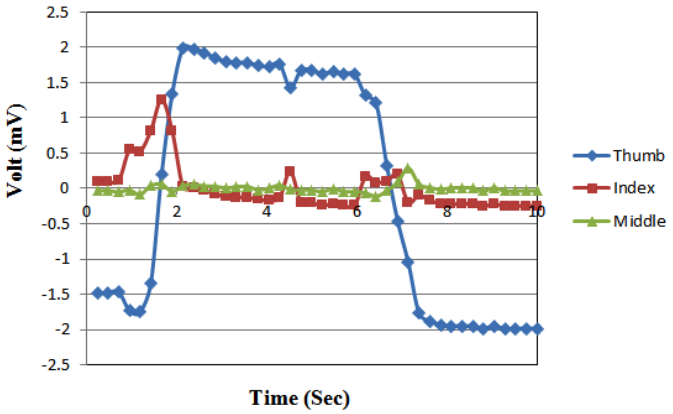

Fig 7: EigenFingers data for fingers bending after PCA

After identifying data from the initial and eigenfingers data, PCA-BMU functions to classify the finger bending data by reducing dimensionality. PCA-BMU basic function was to justify the best matching neuron for finger bending features group. Figure 8 shows the best matching unit (BMU) for the fingers bending in order to justify the clustering feature. According to [19] stated that the training neuron for deciding the BMU and neighborhood using PCA features learning could be occurs in several steps:

a) Each node's weights are initialized.
b) A vector is chosen at random from the set of training data and presented to the lattice.
c) Every node is examined to calculate which one's weights are most like the input vector. The winning node is commonly known as the Best Matching Unit (BMU).
d) The radius of the neighborhood of the BMU is now calculated. This is a value that starts large, typically set to the 'radius' of the lattice, but diminishes each time-step. Any nodes found within this radius are deemed to be inside the BMU's neighborhood.
e) Each neighbouring node's (the nodes found in step d) weights are adjusted to make them more like the input vector. The closer a node is to the BMU, the more its weights get altered.
f) Repeat step 2 for N iterations.

The figures also show the nodes that stay far away from the BMU could be eliminated in order to get the best BMU neighborhood and at the same time BMU capable to help PCA form finger bending features.

Figure 9 shows the clustering grasping feature for PCA-BMU approach. The figures show that the outer data (stated in the figure 9) could be eliminated or the data range could be reduced. The reduction / eliminate process should be considered because of the grasping force feature itself, could be more accurate and always emerges. The figures also show the 2 groups of grasping force. Group 1 shows the maximum data features compare to the Group 2. Meaning that whichever the clustering group shows the maximum dataset, the selected clustering group could be called as the grasping force feature.

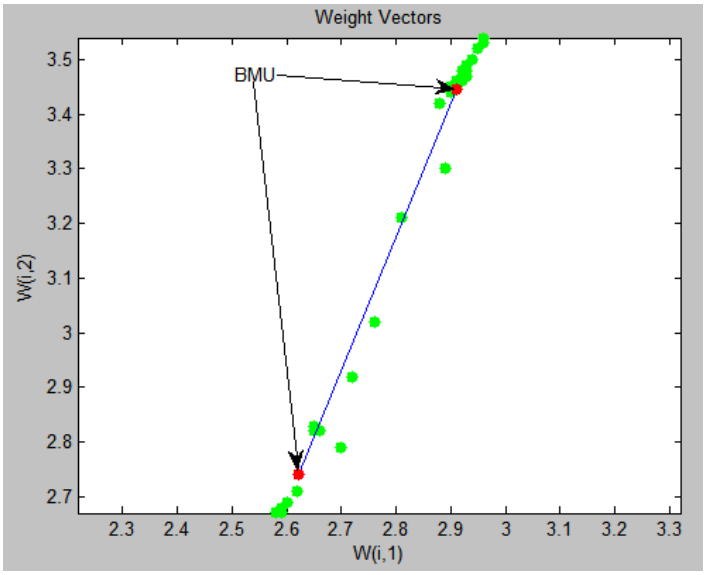

Fig 8: The BMU of finger bending activity

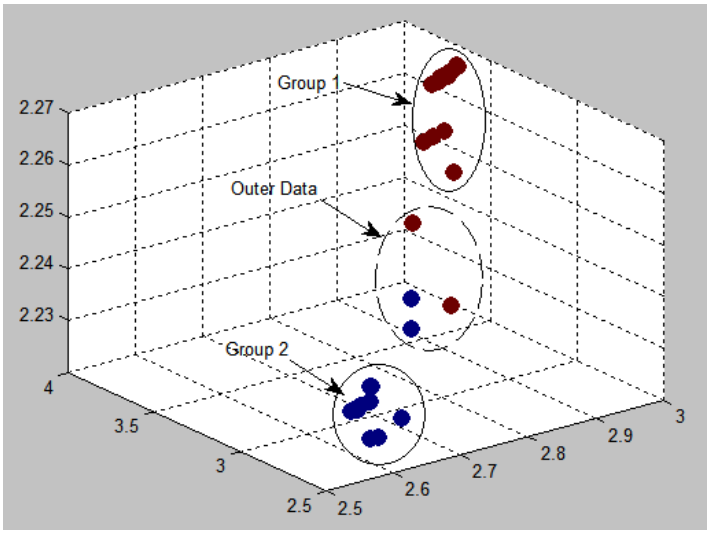

Fig. 9: PCA-BMU data clustering for finger bending activity

CONCLUSION AND FUTURE WORK

In this paper, we proposed a fingertip bending activities for sign language translation via a virtual environment using Principal Component Analysis (PCA) method. The collection of data that measure from the fingertip movement is measured by using GloveMAP and the advantages of the measurement could be perform by the characteristic values of one dimensional data of fingertips bending. The result from these experiments shows that PCA capable to justify all the bending feature and extract the principal components from the degraded fingertips movement. However, it is worth noticing that the new method of fingertips bending activities will result in accurate clustering features for alphabet fingers bending selection. Our future work will be focus on how to use association rule methods and capable to generate the abstract behaviors from the other gesture sequence not limited to the finger movements or bending but the other gesture.

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Nazrul H. Adnan
Advanced Intelligent Computing and Sustainability Research Group, School of Mechatronic
Universiti Malaysia Perlis KampusPauh Putra, 02600 Arau, Perlis, MALAYSIA
Bahagian SumberManusia, Tingkat 17 & 18,
IbuPejabat MARA Jalan Raja Laut, 50609 Kuala Lumpur, MALAYSIA
nazrulhamizi.adnan@gmail.com

Khairunizam Wan[1]
Shahriman AB[2]
Azri A. Aziz[3]
M. Hazwan Ali[4]
Advanced Intelligent Computing and Sustainability Research Group, School of Mechatronic
Universiti Malaysia Perlis KampusPauh Putra, 02600 Arau, Perlis, MALAYSIA
khairunizam@unimap.edu.my[1]
shahriman@unimap.edu.my[2]
azriaziz@unimap.edu.my[3]
hazwan_hafiz89@yahoo.com[4]

Juliana A. Abu Bakar
Department of Multimedia School of Multimedia Tech & Communication College of Arts and Sciences
Universiti Utara Malaysia 06010 Sintok, Kedah, MALAYSIA
liana@uum.edu.my

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Optimum DG Sizing And Network Reconfiguration Simultaneously Based on Evolutionary Particle Swarm Optimization

W.M.Dahalan, H.Mokhlis, M.F. Sulaima & A.H.Abu Bakar

ABSTRACT

Distribution networkplanning and operation require the identification of the best topological configuration that is able to fulfill the power demand with minimum power loss. This paper presentsan efficient hybridization of combination of both Particle Swarm Optimization (PSO) and Evolutionary Programming (EP) methods called the Evolutionary Particle Swarm Optimization (EPSO). The proposed method is used to find the optimal network reconfiguration and optimal size of DG simultaneously. The main objective of this paper is to gain the lowest result of real power lossesin the distribution network and upgrade the voltage profiles in the overall system as well as satisfying other operating constraints.A comprehensive performance analysis is carried out on IEEE 33 bus distribution system.The proposed method is applied and its impact on the network reconfiguration for real power loss and voltage profiles is investigated. The results are presented and compared withthe traditional PSO method.

Keywords: Distributed Generation, Optimization Techniques, Power Loss Reduction, Reconfiguration, Evolutionary Programming.

INTRODUCTION

Most of electrical distribution systems operate usually in a radial configuration due to lower short circuit, simple switching, lower cost of installation and protect equipment with lower reliability.Two types of switches are generally found in the system for both protection and configuration managementwhich are sectionalizing switches (normally closed switches) and tie switches (normally opened switches).One of the most important control schemes in electrical distribution systems is "Distribution Network Reconfiguration" (DNR) which can bring optimal minimization of real loss, improvement in voltage profile and relieving of overloads in the network.The DNR isaffected more through the interconnection of DGs.The growth of DG insertion in distribution system is indeed in the increasing trend because of its vital contribution in the power system performance.According to the statistic in the literature review, [1] has reported that 70% of the total losses occur in the primary and secondary distribution system, while transmission and sub-transmission lines account for only 30% of the total losses. Therefore, considering the best DG insertion in the active distribution network is necessary.

The installation of DG and other devices will incur high cost. It is therefore, determining the suitable DG sizing and its location prior to installation is essential to maintain the network stability

and minimize the power loss in the distribution system. In the meantime, the reconfiguration technique is only required some additional line and controlling methods to improve the consistency of the system. Furthermore, the installation of reconfiguration network is much simple and cost efficient compared to other techniques. Various reconfiguration methods have been proposed in the research to foresee the strengths and weaknesses of each method.Many researchers have been focusing more on overcoming the reconfiguration problem through various approachessuch as Tabu Search [2], Ant Search Colony (ASC) [3-4], Particle Swarm Optimization (PSO) [5-7], Genetic Algorithm[8], Plant Growth Algorithm (PGO) [9]and Bacterial Foraging Algorithm (BFA) [10].However, only a few of them associate DG in their research and foresee DG's impact on the reconfiguration distribution network [2], [3] and [7].On top of that, their reconfiguration system and DG sizing operates in different situation and organize separately.

In this work, the researcher is trying to solve the problem in finding the optimal network reconfiguration and optimal DG sizing simultaneously. Doing it simultaneously will further reduce the cost and increase its efficiency. In order to achieve that, EPSO has been proposed in reconfiguration problems due to its excellent capability for searching globallyoptimal solution to a complex problemand fast convergent.Five distinct cases have been manipulated to foresee their outcomes and results with the presence of DG as well as in the absence of DG.In experimenting the five cases, we only look for the best possible size of DG while the location of DG shall be set constant.The test result of EPSO algorithm is compared with the existingmethod as the conclusion for the minimization of losses and the decrease percentage is shown as the conformation for the success of this optimization.

The particulars of these cases are being discussed in section 2.Meanwhile, Section 3 and 4 show the performance of these algorithms using standard test function.The simulation results in term of power loss and voltage profile are being highlighted in Section 5 and 6 andfinally the lastsection tells the discussion and conclusion of the study.

MATHEMATICAL FORMULATIONS

The connection of DG and reconfiguration techniques in the distribution network will change the direction of power that flow throughout the network.Both techniques are reciprocally complementing each other to reduce the power losses and improve the voltage profile of the system.In this study, the main objective for doing the reconfiguration either with or without DG units is to obtain the minimum active power losses in the system based on active current formulation.Therefore, the objective function of this study is:

$$P_{losses} = \sum_{i=1}^{n} \left| I_{ai}{}^{2} \right| R_i \tag{1}$$

where:

i = Number of lines in the system.
I_{ai} = Line real active current.
Ri = Line resistance.

Furthermore, the power system constraintshave also been considered during the analysis. Since there are four different cases to be analyzed, the general constraints used in the optimization process are:

a) Generator operation constraint:

$$P_i^{\min} \leq P_{DGi} \leq P_i^{\max} \tag{2}$$

All DG units are only allowed to operate within the acceptable limit where P_i^{min} and P_i^{max} are the lower and upper bound of DG output.Therefore, for the analysis that contained the DG units, the DGs size results must not exceed this limit.

b) Power injection constraint:

$$\sum_{i=1}^{k} P_{DG} < P_{Load} + P_{Losses} \quad , k = no.of\ DG \tag{3}$$

In the effort of avoiding power injection for its main grid (substation) from DG unit, the output of DG cannot be more than the total load and the total active power loss in the network.

c) Power balance constraint:

$$\sum_{i=1}^{k} P_{DG} + P_{Substation} = P_{Load} + P_{Losses} \tag{4}$$

The amount of power generated within the network system which comes from the DG unit and the substation must be equal to the amount of total load plus the total power loss. This concept complies with the principle of equilibrium in generating power and demand concept.

d) Voltage bus constraint:

$$V_{\min} \leq V_{bus} \leq V_{\max} \tag{5}$$

The voltage for each bus should operate within the acceptable limit which is in between1.05 and 0.95(± 5).

e) Constraint of Radial configuration:

The configuration must be in radial to avoid excess current flow in the system. Therefore, in order to ensure the radial network is maintained, several constraints must be taken into account. Several standard rules have been adopted for selection of switches. Those switches that do not belong to any loop, connected to the sources and contributed to a meshed network have to be closed.

FUNDAMENTAL OF PARTICLE SWARM OPTIMIZATION

Most of the researchers choose Particle Swarm Optimization (PSO) to solve problems regarding the optimization in power system. The PSO has been developed based on the behavior of social animals which live and move in group such as fish and bird. The birds or fish usually move in a group at a certain speed and position. Their design of movement is depending on their experience

as well as the experience of others in the group (P_{best} and G_{best}). The new velocity, V_m^{t+1} and the new position, X_m^{t+1} for the fish or birds are obtained using Eq. (6) and (7).

$$V_m^{t+1} = \omega \times V_m^t + wf_1 \times ran_1 \times (P_{bm}^t - X_m^t) + wf_2 \times ran_2 \times (G_b^t - X_m^t) \quad (6)$$

$$X_m^{t+1} = X_m^t + V_m^{t+1} \quad (7)$$

where V_m^t is the velocity of particle m in iteration t, X_m^t is the position of particle m in iteration t, ran_1 and ran_2 are the random numbers between 0 and 1 [11]. P_{bm}^t is the best value of the fitness function that has been achieved by particle m before iteration t. G_b^t is the best value of the fitness function that has been achieved so far by any particle. Constants wf_1 and wf_2 areweighting factors of the random acceleration terms, which attract each particle towards P_{best} and G_{best} positions. Lower values of fitness function allow particles to move farther from the target region before they return. The inertia weight ω_i is typically set according to the following equation:

$$\omega_i(n+1) = \omega_i^{\max} - \frac{\omega_i^{\max} - \omega_i^{\min}}{n_{\max}} \times n \quad (8)$$

In Eq.(8), $n_{\max}$ is the maximum number of iterations and $n$is the current iteration number. $w_{i\max}$ and $w_{i\min}$ are maximum and minimum of the inertia weights, respectively. The summary process of implementation of PSO algorithm is as follows:

Step A- Initialization- generate randomly all particles
Step B- Evaluate the fitness function
Step C- Determine P_{best} and G_{best} for all populations
Step D- Evaluate the new speed for each population
Step E- Update the existing position to a new position
Step F- Update the existing speed to the new speed
Step G- Check the stopping criteria –otherwise go to Step B.

In this work, the particles consist of the tie line *(S)* and DG size *(Pg)* as shown in Eq.(9).

$$X_{particle} = \{S_1, S_2, \ldots S_\beta, Pg_1, Pg_2, \ldots Pg_\alpha\} \quad (9)$$

where β is the number of tie line and α is the number of DG.

If the case only to find the optimum value of DG that can minimize the power losses, the particles can be written as:

$$X_{particle} = \{S_1, S_2, \ldots S_\beta, Pg_1, Pg_2, \ldots Pg_\alpha\} \quad (10)$$

Only the particles that satisfyall the constraints in (2), (3), (4) and (5) will be considered as the initial population.

EPSO is resemble to PSO in many ways. This is because EPSO has been developed based on PSO. However, their resemblances stop at the steps E and F where the new *Pbest* and new *Gbest* are determined. In the next subsection, EPSO will be discussed in greater detail.

THE IMPLEMENTATION OF EPSO IN NETWORK RECONFIGURATION AND DG

Generally, the proposed EPSO undergoes the similar steps as the traditional PSO from step A to step D. However, the concept of the EP is then appliedinto steps E(of the previous subsection), where the tournament selection process is done. Basically, EP employs a selection through the tournament scheme to choose the survivals for the next generation. This selection is used to identify the candidates that can be transcribed into the next generation of the combined population of the parents and offspring. In details for this EPSO, after obtaining the new position X_{new}, the new fitness value is determined using the value of new positions. Thus, the set of new position X_{new} and the old set position x will be combined together. This combination of new and old set position will be contested in a tournament as indicated in red dotted line in flow chart. A position gains the score when its fitness is better than other contenders and this tournament is contested as randomly. This tournament selection is a part which is adapted from EP methodthat's different compare to the conventional Particle Swarm Optimization.

Meanwhile in step F, after the tournament and selection process, the positions will be sorted out in descending style, starting with the highest score to the lowest score. The *N* numbers of positions with the best score from the results can be considered as survival positions which are used for the next iteration. These positions have been used as the newest P_{best} and the position with the highest score is used as the newest G_{best}.

Finally, in the last step, the convergence test is required to determine the stopping criteria of this optimization search process. The new position set will be tested for convergence. If convergence is not achieved, the process will be repeated by calculating a new velocity and position by using equations (E) and (F) based on the new local best (P_{best}) and global best (G_{best}). If convergence is achieved, then the optimization process is terminated. The overall flow of EPSO is illustrated in the Figure 1.

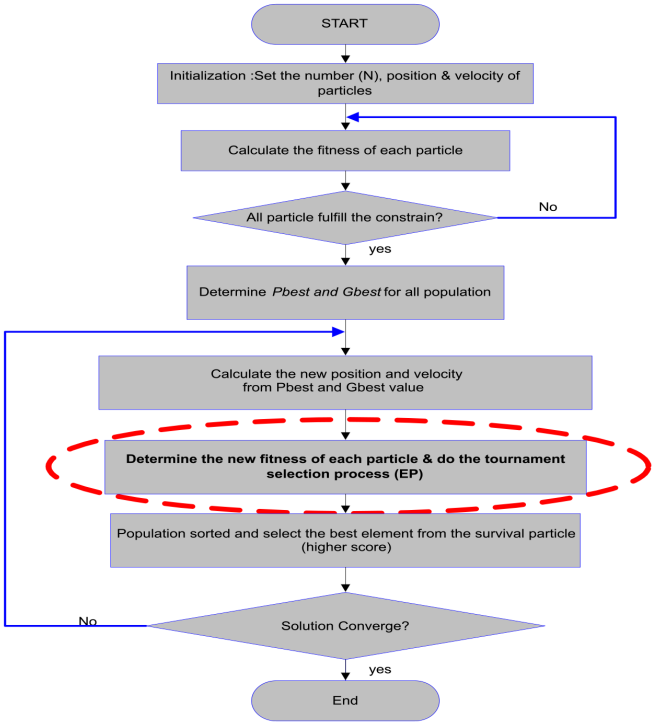


Figure 1: Flowchart for EPSO algorithm

SIMULATION AND ANALYSIS OF THE RESULTS

The test system for the case study consisting of 33-bus radial distribution system as is shown in Fig.2. The system consists of one feeder, 32 normally closed tie line and five normally open tie lines (dotted line) and located on branch No. 33, 34, 35, 36 and 37. The system load is assumed to be constant and Sbase = 100MVA. The line and load data details can be referred in [12]. The total load on the system is 3715kW and 2300kVAr. The minimum and maximum voltages are set at 0.95 and 1.05p.u.respectively. All calculations for this method are carried out in the per-unit system. The convergence value is taken as 0.0001.

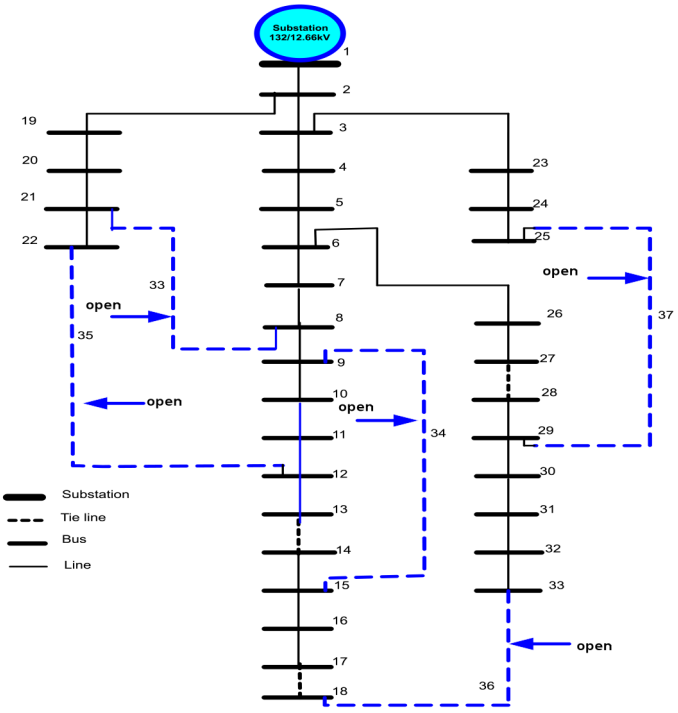


Figure 2: Initial configuration of the 33- bus radial distribution system

DESCRIPTIONS ON FIVE DIFFERENT CASESTUDIES

Five distinct cases has been executed to find out their reliability of having EPSO in the system to achieve the best configuration and the most optimal size of DG.Those cases are described as follows:

In this first case, the system follows the original network distribution of 33-bus without any alteration done. All the tie switches in the network remains as they are without adding any DG units.

In this second case, reconfiguration technique is addedto theexisting systemto foresee its effects of power loss reduction.

In this third case, four DG units are stationedat the most optimal locations of buses 6,18, 22 and 29 respectively.There is no reconfiguration done in this case. Then, the impacts of all these DGs are being analyzed.

In this fourth case,both the reconfiguration and DG have been applied in the system.The system will find the optimal DG size first before conducting reconfiguration. They are done separately.

In this fifth case, both the reconfiguration and DG have been applied simultaneously in the system. Then we can make a better comparison between having used them separately or simultaneously.

OPTIMAL DG SIZING AND RECONFIGURATION IN DISTRIBUTION NETWORK SIMULTANEOUSLY

As mentioned in the previous section, the analysis of reconfiguration involved the network with and without DG units. In the case of a network with DG, the optimal size of DG units is obtained from the simulation in which both parameters DG size and the switches opened (in equation (9)) are adjusted during simulation simultaneously. The size of each DG is already set with the limitation range less than 5MW in the program. In this work, we only determine the optimal size of DG while the location of DG is fixed. DG location shall be constant as a controlled measure in order to observe the responding changes of DG sizing. Tie switch and sectionalizing switch are considered as the main control variables. The optimal power losses are based on flexible switches while the optimal size of DG depends on the optimum power losses value. After this simulation is run randomly at approximately 100 times by using MATLAB software, then only the minimum power loss with optimal DG size is selected. The results obtained consist of the five opened switches, total power loss and three optimal DG sizing.

ANALYSIS OF RECONFIGURATION AND DG INSTALLATION TECHNIQUE

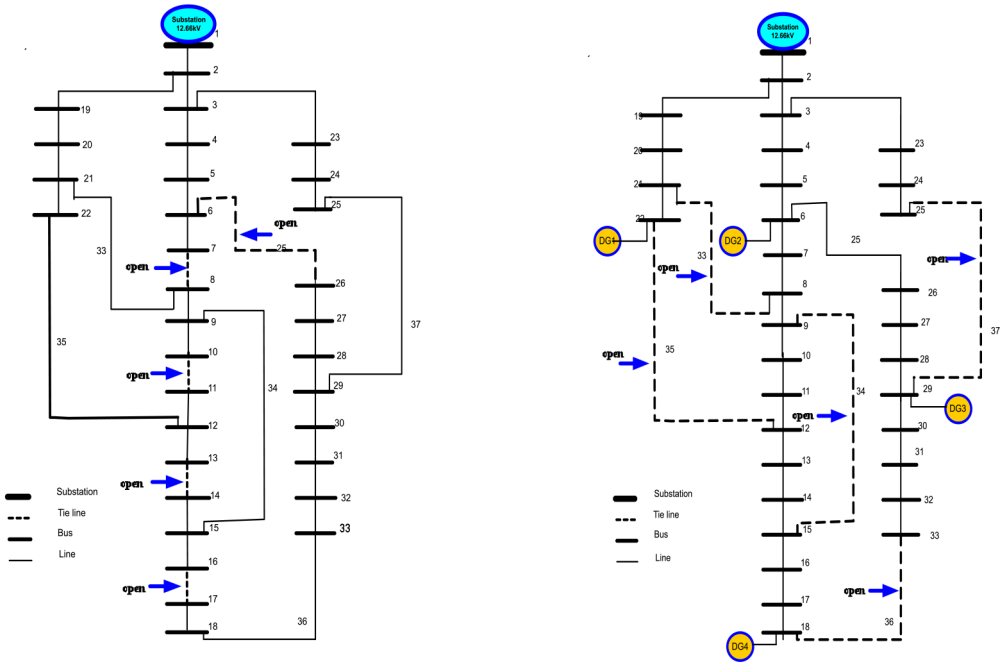
Impact on Power Loss

Since the reconfiguration technique has changed the original configuration network as well as a number of feeders, the impacts of this technique to the power losses and voltage profile of the system need tobe studied and analyzed. The operation of the system using EPSO method in the initial case (case 1) shows that the network of 33-bus system is run without the presence reconfiguration and DG. The network has given the initial total power loss of 202.3kW through five initial open switches of 33, 34, 35, 36 and 37. While in case 2 where the reconfiguration is employed in the network of 33-bus system, the power loss reduction has been improved by 40.4% (202.3kW to 120.5kW). At the same time, the newly opened switches are also shifted to 7, 10, 13, 16 and 25 after reconfiguration. The overall performance of the test is summarized in Table1.

Table 1: The overall performance of the case study (EPSO)

Parameters	Opened Switch					Size of DG (MW)				Total Power Loss (kW)	Loss Reduction (%)	CPU time (s)
Case 1	33	34	35	36	37	-	-	-	-	202.3	-	-
Case 2	16	7	10	25	13	-	-	-	-	120.5	40.4	35
Case 3	33	34	35	36	37	0.731	0.840	1.827	2.335	109	46.1	19
Case 4	36	33	9	7	37	0.729	0.800	1.827	2.250	97.1	52.0	57
Case 5	28	16	13	10	6	0.720	0.741	1.733	2.235	89.3	55.9	46

Meanwhile, in case 3 where the network of 33-bus system is operated by having only DG which is placed on bus number 6, 18, 22 and 29. In this case, reconfiguration is taken out so that we can clearly observe the impact of DG. After the analysis, it is found that the presence of DG does gives lower power loss as compared to case 2. The total power loss is reduced by 93.3kW or 46.1% (from 202.3kW to 109kW). From the improved network system, the sizes of DG are also become optimal; 0.731MW, 0.840MW, 1.827MW, 2.435MW respectively. Figure 3 shows the diagram of the network after reconfiguration and DG installation in the distribution system.



a)Case2: Network after reconfiguration

Total Power Loss=120.5kW

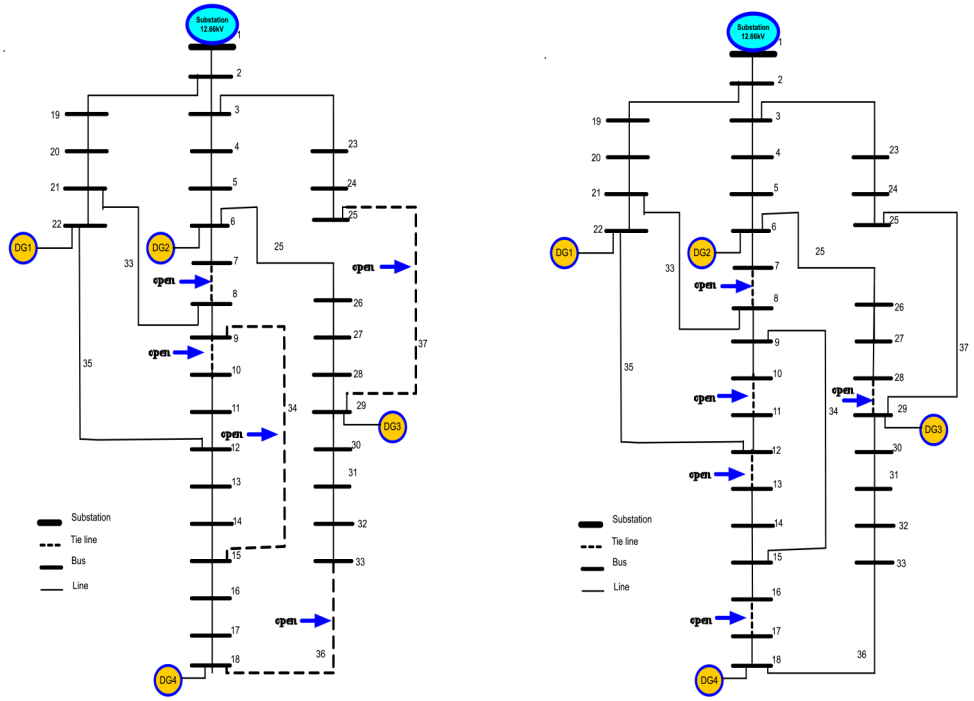
b)Case3: Network with DG installation

Total Power Loss=109kW

Figure 3: Network Reconfiguration with and without DG of 33-bus system using EPSO

In case 4, the operation is conducted by us both reconfiguration and DG. However, reconfiguration process is only being done after the right size of DG has been determined. In other word, both processes are run separately. The results obtained reveal even greater power loss reduction by 105.2kW or 52% as compared to case 2 and case 3. Thus, the presence of bothDG and reconfiguration in the process has indeed led to the reduction of power loss. The new diagram of the network reconfiguration operateswith DGs in splitting and simultaneous mode is illustrated in Figure 4.

The network condition of case 5 study is almost identical to case 4 except that this time both reconfiguration and DG are being organized simultaneously. In other words, the switches that will be opened and the size of DG are determined simultaneously during simulation. The results for the network of 33-bus system show the greatest improvement on power loss reduction of 55.9% (202.3kW to 89.3kW). The optimal size of DG obtained is slightly different from case 4 which are 0.720MW, 0.741MW, 1.733MW and 2.235MW. The analysis of this case has proven the simultaneous presence of reconfiguration and DG yields a much better rate of power loss.The



a) Case4-Network Reconfiguration with DGs
Total Power Loss=97.1kW
(Splitting)

b) Case5-Network Reconfiguration with DGs
Total Power Loss=89.3kW
(Simultaneously)

Figure 4: Different organization network reconfiguration with DG

comparison of power losses of all cases is depicted in Figure 5.Beside that, the computing time taken in case 5only 46 secondsinstead of 57 seconds in case 4 to perform two processes together. Hence, case 5 gives better results in term of CPU time to reach the optimal result. The differential of CPU time is due to the concept used in EPSO which only maintains survival particles. The survival particles are the particles among the population set that given the lowest fitness value when the optimization process is running. So that, it has made the process of convergence becomes faster and consistence. While Case 4 needs longer time because the organization of the two processes has to be done twice and separately.The results of CPU time are illustrated in Figure 6.

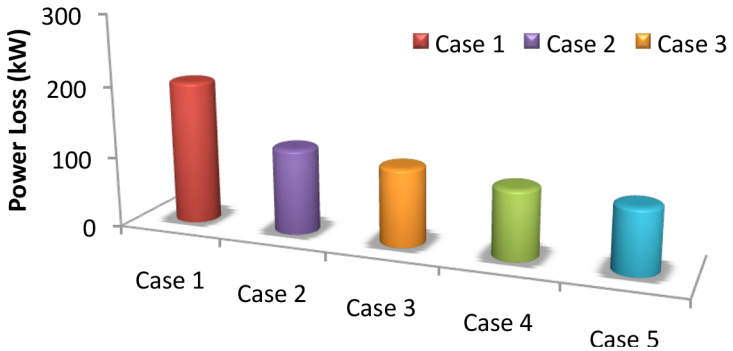


Figure 5: Power losses against cases between with and without reconfiguration and DG

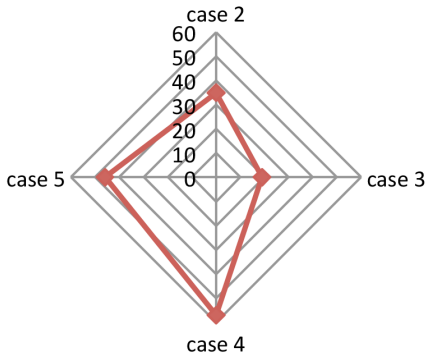


Figure 6: The performance of CPU time of EPSO algorithm

Impact on voltage profile

Network reconfiguration is performed by opening sectionalizing switches and closing tie switch of the network. Normally open tie-switch is closed to transfer the voltage from one feeder to another feeder while an appropriate sectionalizing switch is opened to reduce the active power loss. By doing that, the voltage among the feeders will be balanced and finally improved greatly on the overall voltage profile of the system. The limit for voltage is set between 0.95p.u and 1.05p.u which has been coded in the MATLAB program. Only the voltage which falls within the limit will be accepted for the next process.

Their impact on the voltage profile for all cases of the system operate using EPSO method is depicted in Figure 7. By observing the results, we can conclude that the voltage profile has improved and the average bus voltages have reached exceed 0.950 p.u from 0.91 p.u. In case 2, the system is operated with thepresence of reconfiguration, the voltage profile of the system has been improved considerably with a minimum node voltage of 0.9618p.u.

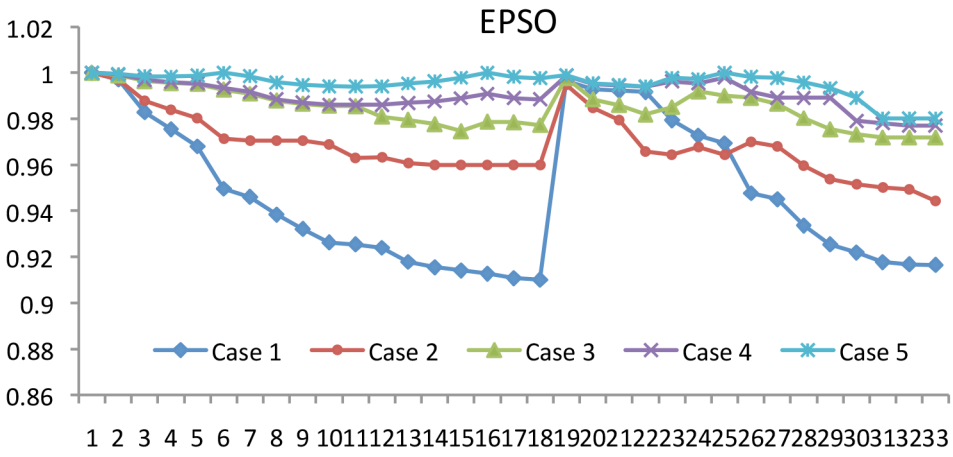


Figure 7: Voltage profile for all cases of the system operate using EPSO

The voltage profile is improved clearly for bus 5 until 16. However, the voltage profile looks almost similar for bus 17 until 19. The rest of the bus only shows slight improvement. Therefore, the implementation of reconfiguration technique has given better voltage profile compared to without reconfiguration. However, in case 3 the voltage profile shows better improvement when

the system operate only with DG which is the minimum voltage profile is 0.9750p.u compared to case 2.

The voltage profile can be improved further through applying reconfiguration and DG sizing separately as mentioned in case 4. However, voltage profile has been improved more effectively whenever the reconfiguration and DG in the system is operated simultaneously as shown in case 5 where all bus voltages satisfy the 0.95p.u voltage constraints and near to 1p.u. The voltage profiles in case 5 for 33 bus systems show the significance of voltage profile changes between bus 15 to 18. The voltage profile improves to 0.9996p.u. This can be clearly seen the differentiation of the voltage profile in all cases as depicted in Table 2. The voltage profile shows the greatest improvement after reconfiguration with DG simultaneously technique is applied.

Table 2: The differences of Vmin and Vmax values in the system with respect to DG output

	DG 1 (MW)	DG 2 (MW)	DG 3 (MW)	DG 4 (MW)	V_{min} (p.u)	V_{max} (p.u)
Case 1 (initial)	-	-	-	-	0.9106	1.00
Case 2	-	-	-	-	0.9618	1.00
Case 3	0.731	0.840	1.827	2.335	0.9750	1.00
Case 4	0.729	0.800	1.827	2.250	0.9908	1.00
Case 5	0.720	0.741	1.733	2.235	0.9996	1.00

Table 3: Comparison of results of the proposed algorithm with another technique

	EPSO		PSO [13]		GA[8]		ACA[3]	
Case study	Opened switch	Power loss (kW)	Opened switch	Power loss (kW)	Opened switch	Power loss (kW)	Opened switch	Power loss (kW)
Case 2 *(Recon)	7, 10, 13, 16, 25,	120.5	7,10,14, 28,32	126	7, 9, 14, 32, 37	137.0	7, 9, 14, 28, 32	137.0
Case 3 (DG)	33, 34, 35, 36, 37	109	33, 34, 35, 36, 37	164	33, 34, 35, 36, 37	164	-	-
Case 4 *Recon +DG (separately)	7, 9, 33, 36, 37	97.1	-	-	7, 9,14, 28, 32	112.0	6,10,14,17, 28	110.3
Case 5 *Recon + DG (simultaneously)	6, 10, 13, 16, 28	89.3	7, 10, 28, 14, 32	92.3	-	-	-	-

*Recon= reconfiguration

In order to find out the most reliable method, the comparison results between the proposed method and the previous methods in Table 3is established to display the test results generated from the attachment of EPSO technique of 33-bus system and other methods. From the table, it can be clearly seen thatthe existence of EPSO in all caseshas generated the lowest amount of power loss as compared to other methods which amounting to only 89.3 kW power loss. Previous track records have shown that very few researchers investigated the reconfiguration technique

with DG mode even though it produces a better power loss figure than without DG mode. It is essential to realize that the reduction in power loss indirectly produces substantial savings on the energy loss cost if we consider on a larger scale.

CONCLUSION

A reconfiguration method of EPSO technique has been introduced.The prime aim of this paper is to reduce the amount of power loss to the lowest possible and at the same time increase the effectiveness of voltage profile. This is done by applying a reconfiguration technique with the presence of DG and with the absence of DG.To prove the reliability of the proposed method, five distinct cases were created on a 33 bus distribution system.

The results obtained and the analysis done from the simulation prove that Case 5(having reconfiguration and DG simultaneously) produces the best output which improve about 56% of power loss reduction and increase about 10% of the voltage profileas compared to the original case.Thus, the simultaneous implementation of DG and reconfiguration is certainly giving great impacts to the whole distribution system.Both factors are equally important to recover some of the power loss while upgrading the system profile.

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W.M.Dahalan, H.Mokhlis, M.F. Sulaima & A.H.Abu Bakar
Faculty of Electrical Engineering,
University of Malaya, 50603 Kuala Lumpur.
Department of Marine Electrical Engineering,
University Kuala Lumpur,
(Malaysian Institute of Marine EngineeringTechnology),
32000, Perak.
Universiti Teknikal Malaysia Melaka, Malaysia
wardiah@mimet.unikl.edu.my,hazli@um.edu.my,
fani@utem.edu.my, abhalim@um.edu.my

* Author to whom correspondence should be addressed;
Email:, wardiah@mimet.unikl.edu.myTel.: +6012-5899066,Fax: +603-79675348

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A Conceptual Model of Interactive Persuasive Learning Among Elderly[1]

Abdul Nasir Zulkifli, Nurtihah Mohamed Noor, Mazida Ahmad, Juliana Aida Abu Bakar & Ruzinoor Che Mat

ABSTRACT

Over the past few years, new and improved learning techniques and technologies have been introduced. Among them, interactive media holds a lot of potential in learning. This technology highly promotes self-directed and active learning approaches and has capabilities to foster the learning process. Furthermore, the emergence of persuasive technology increased the capability of the media features to be used in learning field within variety of ways. Persuasive technology is the attempts of several researchers and its founder to proof the power of persuasion through the computer technology in changing individuals' behavior and attitude. Even though previous studies have highlighted the various features of interactive media contribute to learning, our preliminary study indicated that most of elderly prefers conventional learning approach over computer approach. It is evident that elderly choose the use of computer applications as their last resort in learning. In order to highlight an interactive media system with persuasion elements, this study attempt to propose a conceptual model of interactive persuasive learning system for elderly that can be used in encouraging them to learn using computer-based learning tools. Thus this paper discusses the introduction of persuasive technology and interactive media. Then, we propose the conceptual model of interactive persuasive learning system for elderly that can be used in encouraging them to learn using computer-based learning tools. As for evaluation, the respondents will consist of elderly people (above 40 years old). The collected data will be analyzed using Statistical Packages for Social Sciences (SPSS) and Structured Equation Modeling (SEM) to identify the significant direct relationship effect among the proposed elements. The proposed model will be helpful in designing and developing interactive media systems that can encourage and engage a learning process among elderly.

Keywords: Interactive media, Persuasive technology, Computer-based learning, Structured equation modeling (SEM)

ABSTRAK

Sejak beberapa tahun kebelakangan ini, teknik-teknik pembelajaran dan teknologi baru yang lebih baik telah diperkenalkan. Antaranya, media interaktif merangkumi banyak potensi dalam pembelajaran. Teknologi ini sangat menggalakkan pendekatan pembelajaran kendiri dan aktif dan mempunyai keupayaan untuk memupuk proses pembelajaran. Tambahan pula, kemunculan teknologi pembujukan meningkatkan lagi keupayaan ciri-ciri media untuk digunakan dalam bidang pembelajaran dalam

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pelbagai cara. Teknologi pembujukan adalah cubaan beberapa penyelidik dan pengasasnya kepada pembuktian kuasa pembujukan melalui teknologi komputer dalam mengubah tingkah laku dan sikap individu. Walaupun kajian sebelum ini telah menekankan pelbagai ciri-ciri media interaktif yang menyumbang kepada pembelajaran, kajian awal kami menunjukkan bahawa kebanyakan warga tua lebih suka pendekatan pembelajaran konvensional berbanding pendekatan komputer. Ia adalah jelas bahawa orang tua memilih penggunaan aplikasi komputer sebagai jalan terakhir mereka dalam pembelajaran. Dalam usaha untuk menonjolkan sistem media interaktif dengan elemen pembujukan ini, kajian ini berusaha mencadangkan satu model konsep sistem pembelajaran yang interaktif untuk orang tua yang boleh digunakan untuk menggalakkan mereka belajar menggunakan alat-alat pembelajaran berasaskan komputer. Oleh itu, kertas kerja ini membincangkan pengenalan teknologi pembujukan dan media interaktif. Kemudian, kami mencadangkan model konsep sistem pembelajaran pembujukan interaktif untuk orang tua yang boleh digunakan untuk menggalakkan mereka belajar menggunakan alat-alat pembelajaran berasaskan komputer. Untuk penilaian, responden akan terdiri daripada orang tua (melebihi 40 tahun). Data yang dikumpul akan dianalisis dengan menggunakan pakej statistik untuk sains sosial (SPSS) dan pemodelan persamaan berstruktur (SEM) untuk mengenal pasti kesan hubungan langsung yang ketara antara elemen-elemen yang dicadangkan. Model yang dicadangkan akan membantu dalam mereka bentuk dan membangunkan sistem media interaktif yang boleh menggalakkan dan melibatkan proses pembelajaran di kalangan warga tua.

Kata kunci: Media interaktif, Teknologi pembujukan, Pembelajaran berasaskan komputer, Pemodelan persamaan berstruktur (SEM)

INTRODUCTION

Plethora researchers have discussed the interactive media system elements that evince persuasion impact to the users such as motivation (Fogg, 2003; Fogg, 2009; Harjumaa et al., 2009; Lehto & Oinas-Kokkonen, 2009; Oinas-Kokkunen & Harjumaa, 2009; Albaina et al., 2009; Oinas-Kokkunen & Harjumaa, 2008), personalization (Berkovsky et al., 2012; Harjumaa et al., 2009; Lehto & Oinas-Kokkonen, 2009; Oinas-Kokkunen & Harjumaa, 2009), emotional (Dormann, 2000; Looije et al., 2010), ethical issues (Fogg, 2003; Fogg, 2009; Davis, 2009; Davis, 2012; Khaled et al., 2006), experience (Fogg, 2003; Fogg, 2009; Albaina et al., 2009; Berkovsky et al., 2012; Dormann, 2000), cognitive process comprehension (Fogg, 2003; Oinas-Kokkunen & Harjumaa, 2009; Fogg et al., 2007) and others. Each researcher has described the elements from their point of view in relation to previous literatures and studies, however, the most obvious attempts is to reveal the best ways and the best-needed elements in engaging, attracting and finally persuading peoples to the targeted behaviors and attitudes through an interactive media systems. Even though, there are many interactive persuasive elements, this study only focuses in four elements, which are: motivation, cognitive process, emotional appeals and experience.

LITERATURE REVIEWS

In recent years, there has been a vast interest in discovering how computer and information technology influences, motivates and persuades peoples in changing their behaviour and attitudes. Called as persuasive technology or more exclusively known as persuasive computer, this technology promotes an interactive technology that can change a person's attitudes or behaviours (Fogg, 2003). It regularly used in many areas such as public health and management (Albaina et

al., 2009; Lehto & Oinas-Kokkunen, 2011), sales (Dormann, 2000), religion (Yusoff et al., 2010; Yusoff et al., 2011), military training and others. Furthermore, presently, the persuasiveness experiences can come to us in plethora technologies such as web-based applications, portable hand-held devices (Albaina et al., 2009), robots (Looije et al., 2010), computerized toys (Fogg, 2003), game applications (Khaled, 2008) and as well as standalone applications (Oinas-Kukkonen & Harjumaa, 2008; Yusoff et al., 2010; Yusoff et al., 2011). It obviously seen that creating human-computer interaction designs up to date requires the skill of motivating and persuading peoples through the developed products or applications (Fogg et al., 2007).

In fact, central to the concept of persuasive technology is persuasion. B.J. Fogg the apprentice of persuasive technology defined persuasion as "*an attempt to change behaviours, attitudes or both (without using coercion or deception)*" (Fogg, 2003). Thus, the 'captology' word has been coined by Fogg (2003) by the way of a specific study of computers as persuasive technology that focuses on human-computer interaction. In order to increase the capabilities of persuasiveness success, captology set its focus on the computer programs that have been planned to have persuasiveness elements, not as a side effect. A computer system or product that has changed the way peoples think, feel and act, whereby the changes are not planned before to persuade peoples as such is a side effect. In other words, captology refers to computer systems that have been planned by the designers in their designs to persuade peoples intentionally through any focused behavioural or attitudes changes, not in unintentionally (Oinas-Kukkonen & Harjumaa, 2008; Yusoff et al., 2010; Yusoff et al., 2011).

As a factor in persuasion, Fogg (2003) describes three types of persuasive elements, which called the Functional Triad, in the computer technology that can be used as persuaders. Fig. 1 depicts the elements in his study.

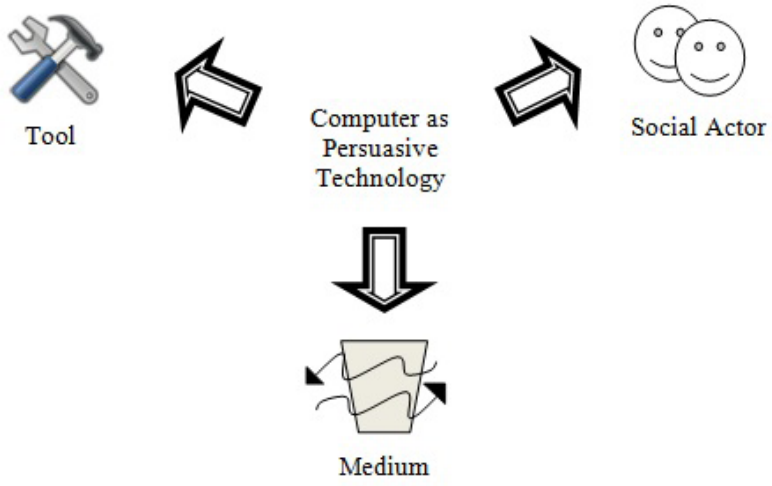

Figure 1: Persuasive Elements in Computer Area

According to Fogg et al. (2007), generally, a computer as a tool is designed to influence peoples' in changing their behaviours and attitudes by increasing the peoples' abilities or by making a task become easier. There are four general ways in which computers can be as a persuasive tool; a) by increasing the peoples' self-efficacy; b) by providing tailored information to the peoples; c) by triggering decision making; and d) by simplifying or guiding peoples through a process. These ways to some extent can increase peoples' belief and capabilities in changing their behaviours and attitude (Fogg et al., 2000).

The next area of the functional triad deals with computers as a medium or a persuasive media. In this area, the medium is referred to the power of simulations generated by computers program. The simulated environment gives experience to peoples whereby in the other hand can influence somebody behaviours and attitudes (Fogg, 2003; Fogg et al., 2007). As stated by Fogg et al. (2007), there are three types of computer simulations that can be use in persuasive technology namely; a) simulated cause-and-effect scenarios; b) simulated environment (such as virtual reality environment); and c) simulated objects. The experience, particularly with prolonged and repeated interaction, evinces the behaviour and attitude changes. The final area of the triad emphasizes computers as a persuasive social actor. As a persuasive tool a computer program or application can be persuasive by rewarding people with positive feedback, modelling some intended behaviour or attitude to be improved in the program, or by providing a social support (for example, influence peoples through praise or criticism) (Fogg, 2003; Fogg et al., 2007). Relating to this study, previous literatures have discussed the persuasiveness in interactive media applications (Fogg, 2003; Lehto & Oinas-Kukkonen, 2011; Albaina et al., 2009; Dormann, 2000; Looije et al., 2010). Obviously, a well-designed interactive media application that intentionally implemented to persuade peoples in changing their behaviours and attitudes can be a good persuader (Fogg, 2003; Fogg et al., 2007).

In fact, been a long time, interactive media has been used widely in the industry, education and learning, business and others. Interactive media in learning comprises the combination of any text, graphic, animation, video and audio elements in the knowledge construction process and provides an active learning environment to the learners (Mayer, 2005; Neo & Neo, 2001). Interactive media certainly has the potential to convey information in an attractive way and understandable to the learners (Shank, 2005). The use of interactive media also promises the value of information conveying to be more effective, especially in the area of learning (Ng & Komiya, 2000). Instead of only using the traditional method in conveying information, the use of interactive media in learning exposes learners to both auditory and visual channels. Furthermore, both systems significantly can increase the capability of learners in memorizing, retrieving back the information and deeper in understanding.

According to Mayer (2001), interactive media learning that combines animation with narrations generally improves in performance on retention tests better than the information only displayed on text or narration. Lindstrom (1994) stated that, users remember 20% of what they see, 40% of what they see and hear, but about 75% of what they see and hear and do simultaneously. The combination of multiple elements seems to increase what has been presented. Dyer and Observe (1996) stated that on average, a learner will retain 10% of what they read, 20% of what they hear, 30% from pictures they see and 50% from watching what has been presented in a learning process. On the other hand, instead of only focusing on the pedagogical learning method using the interactive media technology, there are also plenty of studies related to elders and the technology. However, as has been aware, to persuade elders to use interactive media application is challenging. In order to persuade the elders to use interactive media technology in learning required special attention.

Previous literatures depicts there are several studies which proposed variety of interactive media systems and tools for the persuasion impact for elderly such as (Lehto & Oinas-Kukkonen, 2011; Albaina et al., 2009; Dormann, 2000; Looije et al., 2010). However, there are very little study concentrates on the learning area. In order to develop a persuasive computer application for the elders, a best suite of interactive media features must be discovered.

From the previous studies, five interactive media features have been selected; layout and consistency, simulation, perceived usefulness, perceived ease of use and multi-touch display to be in an interactive media application. The features lead to motivation, experience, better cognitive process and emotional appeal that can be factors to increase persuasion impact. Performance, satisfaction, acceptance and perception is the widely used measures in evaluating interactive media and persuasiveness (Yusoff et al., 2012; Albaina et al., 2009; Fogg, 2003; Fogg, 2009). Further explanations about the conceptual model of interactive persuasive learning system for elderly, is explained in the next section.

THE PROPOSED CONCEPTUAL MODEL

This study proposes a conceptual model that is form by three broad categories; interactive media features (layout and consistency, simulation, perceived usefulness, perceived ease of use and multi-touch display), interactive persuasive elements (motivation, experience, cognitive and emotional appeal) and the learning outcomes (performance, satisfaction, acceptance and perception) as shown in Fig. 2.

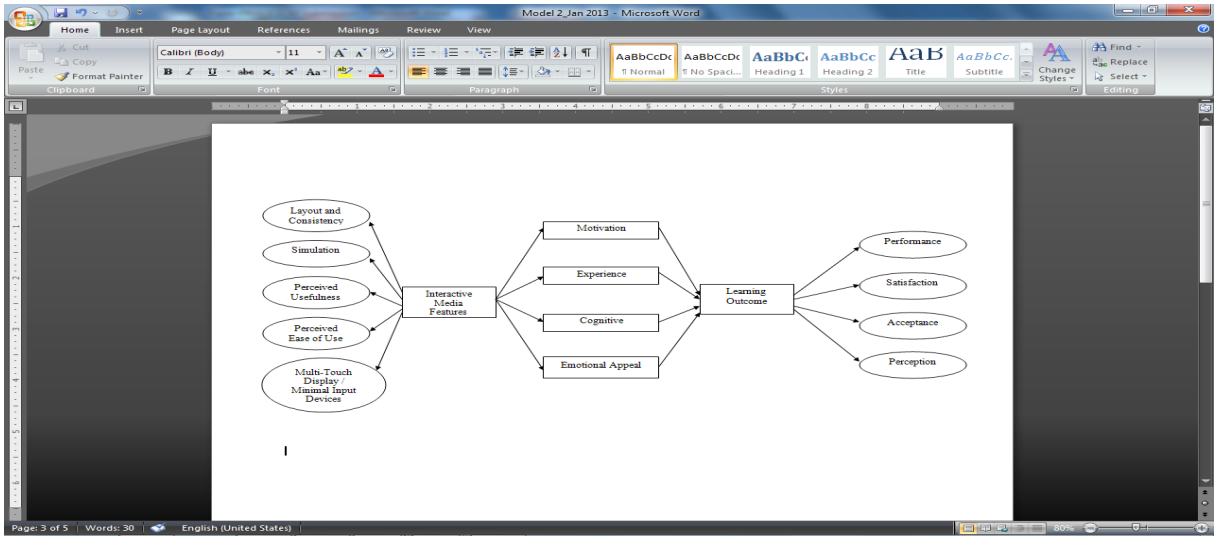

Figure 2: The Proposed Conceptual Model

In relation to the interactive media features, layout is referred to any multimedia elements that will be displayed in an application whether fonts, colors, graphics, videos and animations. There are guidelines to maximize the layout selection, placement and arrangement based on elders (AgeLight, 2008; Stewart & Waight, 2008; Albaina et al., 2009). However, the layout must offer consistency throughout every site in view of certain elders' cognitive limitations such as; vision impairment and to grab their attention by avoiding chaos layout. Simulation in the computer applications are variety and commonly utilize two-dimensional (2D) or three- dimensional (3D) animations and objects. The 2D and 3D simulations help learners to better understand what information or explanation is about. Moreover, a simulation environment that has been created to facilitate learners to learn, can simplify their understanding without actually performing the tasks in the real world (Jawdat et al., 2011; Fogg, 2003).

In order to ensure an interactive media is well-suited to the elders, the media should be perceived usefulness. The perceived usefulness refers to the degree to which the user believes that using a computer technology (application) will improve their performance. Meanwhile perceived ease of use stresses on how effortless using the technology will be. It refers to the system whether it is easier to be used, save energy and has the intention to be used repeatedly (Nasution, 2009). Generally, both are considered different factors in influencing user's attitude towards using the computer application. The perceived ease of use is also hypothesized to influence perceived usefulness and attitude towards using the application. Such attitude determines the behavioral intention to use that application. Multi-touch display uses the touch technology whereby a user can use their fingers in order to interact with a computer application. The multi-touch display can be best alternative to simplify elders with no experience with the other input devices.

On the other hand, research has shown that technology features could influence learning outcomes (Jawdat et al., 2011). The psychological factor has been found to have effect on learning effectiveness by many researchers. Previous educational researchers have emphasized the importance of motivation in learning (Huang et al., 2006). Although motivation is not related to the above explanation, in other studies of human thought processes, the human motivations are endorsed by the cognitive processes. For example, a learning process will be easier to be handled as if the learners (adult learners) have some thought about the importance of learning (Knowles, 1991). A learning process might be appealed if the lesson material can grab the learners' attention. As a prove, previous studies of the human memory and information processing have revealed that well organized learning materials such as interactive media technology learning material causes the learners to develop and maintain their interest in the lesson content (Lee & Boling, 1999). Directly, it enhances the learners' motivation to engage with the lesson.

Relating to elderly computer based learning, as mentioned by Lee et al. (2010), the elderly are quite receptive about the adaptation of new technology, and usually motivated to invest if a lot of benefits can be obtained. Besides that, by offering some new experiences and observe the link between cause and effect from the developed application (for example from the simulated environment), can also be an influential persuasion impact to the elderly (Fogg, 2003; Ijselsteijn et al., 2007). Promoting self-learning or active-learning to the learners are also a way of gaining experience from the interactive media. Cognitive benefits refer to better memorization, comprehension, application and overall view of the lesson learned (Lee et al., 2010). With increased age, there are certain limitations that must not be overlooked. According to Ijselsteijn et al. (2007), the cognitive processes that decline with age basically related to attention process, working memory, discourse comprehension, problem solving and reasoning and memory retrieval. Related to this, the application design layout should be readability, simplicity and consistency throughout all the pages. There are also studies that emphasized the importance of persuasion words to persuade elderly in completing certain task (Fogg, 2003; Albaina et al., 2009), which are closely related with their emotional appeal. Table I and Table II simplifies several findings for the above discussions.

Hence, this proposed conceptual model represents a complete causal relationship, starting from the interactive media features to the persuasive elements and the outcomes; performance, satisfaction, acceptance and perception. Researches have shown that the persuasion impact can be accessed through the performance of activities, satisfaction, acceptance and perception towards the developed invention.

Table I: Element of Interactive Media

Element Of Interactive Media	Author	Discussed Outcome
Layout and Consistency	-Ho (2006) -AgeLight (2008) -National Institute of Aging (2002)	-Usability -Usability
Simulation	-Dalgarno et al. (2002) -Kalawsky (2000) -Yusoff (2012)	-Effectiveness -Effectiveness -Acceptance, usability
Perceived Usefulness	-Davis (1989) -Lee et al (2010)	-Acceptance, productivity, performance, effectiveness -Performance, Perception, Satisfaction
Perceived of Use	-Davis (1989) -Lee et al (2010)	-Acceptance, productivity, performance, effectiveness -Performance, Perception, Satisfaction
Multi-Touch Display / Minimal input Device	-Albaina et al. (2009) -Yusoff (2012)	-Acceptance, Perception -Acceptance, usability

Table II: Element of Persuasive and Interactive Media

Element Of Persuasive & Interactive Media	Author	Discussed Outcome
Motivation	-Albaina et al. (2009) -Lehto & Oinas-Kukkonen (2011) -Fogg (2003), Fogg et al. (2007) -Harjumaa et al. (2009) -Oinas-Kukkonen & Harjumaa (2009) -Rodriguez et al. (2012)	-Acceptance, Perception -Perception -Perception -Perception -Usability, Perception
Experience	-Lee et al. (2010) -Yusoff (2012) -Fogg (2003), Fogg et al. (2007) -Berkovsky et al. (2012)	-Performance, Perception, Satisfaction -Acceptance, usability -Perception -Effectiveness
Cognitive	-Oinas-Kukkonen & Harjumaa (2008) -Yusoff (2012) -Salam (2010)	-Acceptance -Effectiveness -Acceptance, Usability
Emotional Appeal	-Dormann (2000) -Albaina et al. (2009), Looije et al. (2010)	-Effectiveness -Acceptance, Perception

METHODOLOGY

This research consists of four phases which include theoretical study, expert review, survey and model validation.

In the theoretical study phase, a thorough reading on the theories about interactive media, persuasive learning and learning concepts is conducted to understand the domain of the study. The factors of interactive media, persuasive learning and relationship between interactive media and persuasive learning among elderly will be investigated. Reviews of literatures will be carried out to gather information related to this study. Once the information has been gathered, a critical analysis will be conducted on existing theories, which will lead to the identification of interactive media factors for persuasive learning among elderly.

The second phase is the expert review phase that focusing on gathering information pertaining to interactive media and persuasive technology which will lead to the formation of a conceptual model for this study. Then, the hypothesized models based on the conceptual model will be produced to construct the instrument for the study. The instrument will be updated based on the responses from the pilot study.

Next, a survey will be conducted whereby questionnaires will be produced and distributed to appropriate respondents. The respondents will be elderly people (above 40 years old). The purpose is to test the model with the data and the correlation of interactive media and persuasive learning factors towards the persuasive effect of learning among elderly.

Finally, the collected data will be analyzed by statistical technique, using SPSS and Structural Equation Modeling (SEM) and. SEM is a technique to analyze causal relationship among the independent and dependent variables simultaneously and test fit of a model with the data (Ho, 2006). SEM is a technique of analysis that includes measurement error to comprehend other influencing indicator (Conley et al., 2005; Kline, 2010). The outcome from this survey will reveal a conceptual model of interactive persuasive learning among elderly that consists of relationship between the factors of interactive media and persuasive learning to enhance the learning effectiveness among elderly. Table III presents the research methodology completely for this study. The outcome of this study is a conceptual model of interactive persuasive learning system for elderly in encouraging learning process.

Table III: The Phases of Methodology

PHASE	ACTIVITY	OUTCOMES
Phase I	Theoretical Study	-Interactive Media Features
		-Persuasion Strategies Factors
		-Interactive Persuasive Learning Outcomes
Phase II	Expert Review	-Validated Conceptual Model
		-Hypothesized Model
Phase III	Survey	-Instruments Development
		-Model Effectiveness and Correlation
Phase IV	Model Validation	-Validated Model Variables

CONCLUSION

The proposed conceptual model will be helpful for the individuals or institutions to understand the prominent elements of encouraging elderly to learn and what they prefer for learning through the computer based material. The model not only contribute to the body of knowledge in computer

learning field, but also promises the continuity of learning habit with no age boundaries through the latest technology. The capabilities of interactive media in transferring knowledge interactively and attractively should be a platform to increase knowledge to the society.

List of Abbreviations

SPSS	Statistical Packages for Social Sciences
SEM	Structured Equation Modeling

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Abdul Nasir Zulkifli[1]
Nurtihah Mohamed Noor[2]
Juliana Aida Abu Bakar[3]
School of Multimedia Technology & Communication, College of Arts & Sciences
Universiti Utara Malaysia
06010 Sintok, Kedah Darul Aman, MALAYSIA
nasirzul@uum.edu.my (019-4707131)[1]
nurtihah_83@yahoo.com.my (013-2603107)[2]
liana@uum.edu.my (019-4585856)[3]

Mazida Ahmad[1]
Ruzinoor Che Mat[2]
School of Computing, College of Arts & Sciences
Universiti Utara Malaysia
06010 Sintok, Kedah Darul Aman, MALAYSIA
mazida@uum.edu.my (019-5761252)[1]
ruzinoor@uum.edu.my (019-4726820)[2]

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A Comparative Study of Heart Murmurs Feature Extractor

Kamarulafizam, Sh Hussain, Salleh, Arief. A. Harris, K. Yusoff,
Alias M. Noor, Hadrina Sh-Hussain & A.S. Rahmani

ABSTRACT

Heart sound analysis can provide lots of information about the heart condition whether it is normal or abnormal. Heart sound signals are time-varying signals where they exhibit some degree of non-stationary. Two techniques have been proposed to analyze the heart sound from very different aspects in selecting the most unique features. The first technique is the Time-Frequency Analysis (TFA) using B-Distribution, used to resolve signal's components in the time-frequency domain and specifies the frequency components of the signal that is changing over time. Singular Value Decomposition (SVD) is used to obtain the important features out of the time-frequency distribution data. The second technique is focused on the Mel-Frequency Cepstrum Coefficient (MFCC), which is used to obtain the cepstral coefficients by resolving signal's components in the frequency domain. Experiments were set up to extract features of heart sound and comparison was made between these proposed techniques. The approach was tested against sixty one patients with normal and abnormal type of heart sound and murmurs. Neural Network was used to train and classify the heart sound into normal and abnormal class. The result shows that the TFD and MFCC are able to correctly classify up to 96% and 80% respectively.

INTRODUCTION

Heart sound is a time varying signal where the signal content changes over the time. The changes occur in a very short duration, which makes the analysis by auscultation is rather difficult and subjective. Furthermore the analysis by the physician is depending on the hearing capability and experience and this situation may lead to false prognosis. Thus, the development of a standard and computerized system is extremely necessary to overcome this problem. The use of conventional non-invasive analysis tools such as electrocardiogram and acoustic stethoscope is no longer providing a promising result, as all such diagnosis outcome has to be verified by the echocardiogram machine. The current diagnosis approach of acoustic stethoscope and electrocardiogram provide a limited revelation about the disease of the heart. Therefore, with the advancement of the digital signal processing technology, it is believed that there are something else can be obtained from the stethoscope and electrocardiogram for example through the analysis in the frequency domain. As for this research, the acoustic signal from the electronic stethoscope is processed by the advanced signal processing algorithm to reveal the important information and to provide a promising diagnosis result as good as the echocardiogram machine.

Current analysis and diagnosis of heart disease utilizes echo technology in a machine called echocardiogram. It is a non-invasive approach and capable of giving a very clear picture of

the heart condition deep down to the valves and the heart chamber. One can see the working mechanism of the heart without having to go for a surgery. This is the main advantage of this machine. Other than that, this machine is very expensive where the current market price can go up to USD700,000. In a country like Malaysia, it is rather difficult to find a general hospital having more than one unit of this machine. Furthermore, it is impossible for one unit of such machine to be used to accommodate a large number of populations. Typically, a patient has to wait for a long time before the disease is properly diagnosed and treated.

METHODOLOGY

The literature study has shown a massive amount of work that has been carried out in trying to predict heart disease based on its sound. Conventional approach of analysis such as digital filters has no longer attracts the researcher and the new approach based on the time-frequency analysis has come to the attention. This paper is tailored toward experiments on two types of feature extraction techniques which is Time Frequency (TF) and Mel Frequency Cepstrum Coefficient (MFCC) as shown in Fig. 1.

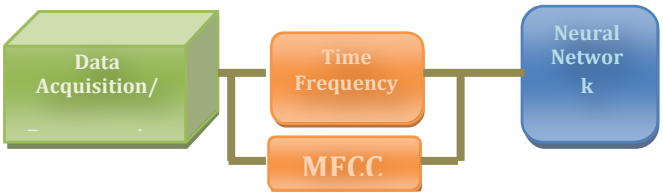


Figure 1. Overall System Architecture

Time Frequency Analysis

In [1], the authors have used Pseudo-Wigner-Ville distribution (PWVD) to detect two types of heart murmurs while in [2], Choi-Williams distribution (CWD) has been used with an exponential kernel. An experiment comparing the performance of Wigner-Ville distribution (WVD) and windowed Wigner-Ville distribution (WWVD) on the analysis of heart sound was conducted and the authors found that WWVD produced more accurate time-frequency representation compared to the WVD and the signal-to-interference is used to quantify the improvement [3]. There are also work that has been conducted the analysis of the heart sound and murmurs using the Windowed Wigner-Ville distribution (WWVD) and smooth windowed Wigner-Ville distribution (SWWVD) [4]. It is found that the most accurate time-frequency representation can be achieved using the SWWVD.

However in 1999, [5] had proved that B-distribution can resolve close signals in the time-frequency domain that other time frequency members fail to do so. Using synthetic and real-life multi-component signals, it has been shown that the B-distribution achieves a better time-frequency resolution and energy concentration around the instantaneous frequency of a signal, while still significantly suppressing the cross-terms.

The general form of bilinear class of time-frequency distribution can be defined as in equation below:

$$\rho(t,f) = \iiint g(v,\tau) z\left(u+\frac{\tau}{2}\right) z^*\left(u-\frac{\tau}{2}\right) e^{j2\pi(vu-vt-f\tau)} dv du d\tau \quad (1)$$

where $g(v, \tau)$ is referred to as the kernel function and is used to define the properties of the distribution and $z(t)$ is the analytic signal associated with the real one. The type of time-frequency distribution is actually determined by the choice of this kernel function. Since in real-life analysis the practitioner is often required to deal with discrete-time signals, therefore it has considered a discrete-time formulation of the proposed TFD. The discrete-time version of the above expression is given by

$$\rho(n,f) = \sum_{m=-M}^{M} \sum_{p=-M}^{M} G(p,m) z\left(n+p+\frac{m}{2}\right) z^*\left(n+p-\frac{m}{2}\right) e^{-j2\pi mf} \quad (2)$$

Here, the discrete-time expressions $G(n,m)$ and $z(n)$ are obtained by sampling G(t,τ) and $z(t)$ at a frequency $f_s = 1/T$ such that $t = n \times T$ and $\tau = m \times T$. The total signal duration is T_z, with N being the total number of samples.

Fig. 2 and Fig. 3 show the results of the normal and abnormal heart sounds in time-frequency domain. The raw data is transformed using B-distribution. Simulations have shown that β = 0.01 gives visually most appealing results for various multicomponent signals.

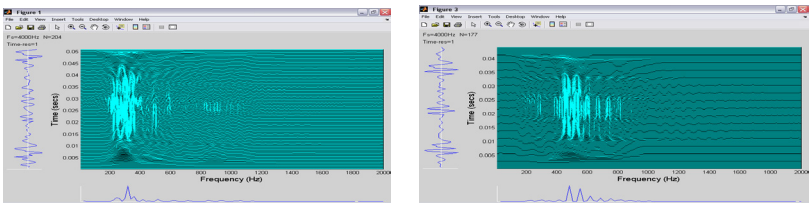


Figure 2.TFD of Normal Heart Sound

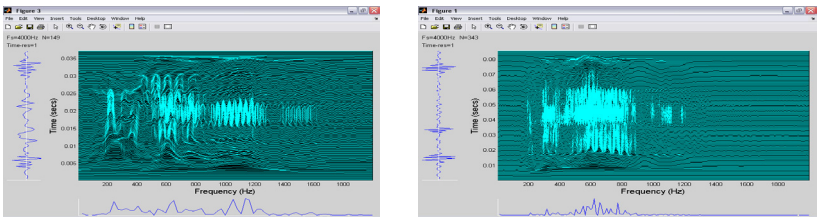


Figure 3. Abnormal Heart Sound

Fig. 2 is an example of the abnormality due to the mitral regurgitation while Fig. 2 is caused by pericardiatis and aortic regurgitation. The patterns are slightly different from the normal heart sound in terms of the components where they have some additional components in the signal. These extra components are actually the abnormalities of the heart sounds called the murmurs.

Feature Decomposition using Singular Value Decomposition (SVD)

The TF distribution produce a lot of information and it is redundant for a classifier to handle. Thus, it is much more appropriate to decompose the information into a smaller dimension of data which can simplify the classification task later on. For this purpose, the singular value decomposition (SVD) algorithm is used to extract only the dominant characteristic out of the time

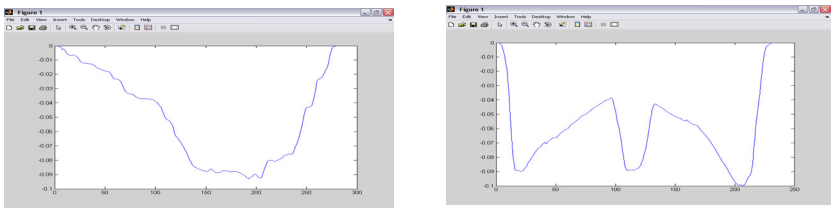
frequency distribution. Dimensionality reduction is almost always essential when time-frequency representations (TFRs) are used as a feature basis; the descriptive ability of most TFRs comes at the expense of high dimensionality. The SVD equation for an (m x n) singular matrix $\boldsymbol{X}$ is:

$$\boldsymbol{X} = \boldsymbol{USV}^T \tag{3}$$

where $\boldsymbol{U}$ is an (m x n) orthogonal matrix, $\boldsymbol{V}$ is an (n x n) orthogonal matrix and S is an (m x n) diagonal matrix containing the singular values of $\boldsymbol{X}$ arranged in decreasing order of magnitude. The SVD equation (3) takes the form:

$$X = \mathrm{A} = \begin{pmatrix} u_{11} & u_{12} & u_{13} & \dots & u_{1m} \\ u_{21} & u_{22} & u_{23} & \dots & u_{2m} \\ u_{31} & u_{32} & u_{33} & \dots & u_{3m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ u_{m1} & u_{m2} & u_{m3} & \dots & u_{mm} \end{pmatrix} \begin{pmatrix} \sigma_{11} & 0 & 0 & \dots & 0 \\ 0 & \sigma_{22} & 0 & \dots & 0 \\ 0 & 0 & \sigma_{33} & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & \sigma_{nn} \end{pmatrix} \begin{pmatrix} v_{11} & v_{21} & v_{31} & \dots & u_{n1} \\ v_{12} & v_{22} & v_{32} & \dots & u_{n2} \\ v_{13} & v_{23} & v_{33} & \dots & u_{n3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ v_{1n} & v_{2n} & v_{3n} & \dots & u_{nn} \end{pmatrix}$$

Some singular values are equal or very close to zero. A singular value s_j describes the importance of u_j and v_j, and when its value approaches zero it indicates that these associated vectors are less significant. This function produces a diagonal matrix S, of the same dimension as X and with nonnegative diagonal elements in decreasing order, and unitary matrices U and V. Fig. 4 illustrates plots that are derived from applying SVD to normal and abnormal heart sounds data set. The figures show that the plots of the abnormal heart sounds do not give the smooth curve lines as compared to the normal plots. This eigenvectors are dominated by high-frequency components that can only come from the abnormal sounds or murmurs produced by the heart of unhealthy people.



(a) (b)

Figure 4.SVD of Heart Sound (a) Normal, (b) Abnormal

Mel-Frequency Cepstrum Coefficient (MFCC)

MFCC is known to perform well in speech analysis research [7], [8], and [9]. In MFCC, the frequency bands are positioned logarithmically (on the Mel scale) which approximates the human auditory system's response more closely than the linearly-spaced frequency bands obtained directly from the FFT or DCT. Heart Sound requires the same concept of processing as the frequency band of heart sound signal overlapped with the frequency band of human speech (human speech: 200 Hz-8kHz, heart sound: 10Hz-1kHz). Applying the same approach to the heart sound signal may reveal hidden features of the heart diseases.

Fig. 5 shows the method to extract features using MFCC technique. The output to the MFCC is a signal representation provided by a set of mel-frequency cepstrum coefficients as a result of cosine transform of the real logarithm of the short-time energy spectrum expressed on a Mel-frequency scale. The steps to compute MFCC are:

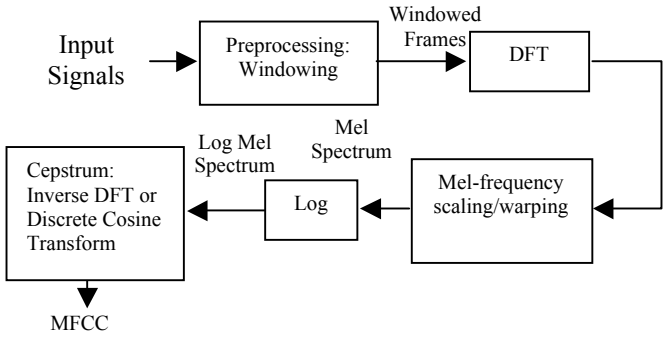


Figure 5. MFCC Computational Procedures

The frequency scaling is used to map linear frequency into Mel-frequency scale, which is linear below 1 kHz, and logarithmic above. Mel-scale frequency analysis can be approximated by equation:

$$Mel(f) = 2595\log_{10}(1 + f/700) \tag{4}$$

where f is the frequency based in hertz. Based on this assumption, the mel-frequency cepstrum coefficient is proposed. Fig. 6 and Fig. 7 show the Mel-Frequency Cepstrum Coefficient of normal and abnormal heart sounds. Fig. 6 shows the result of the Mel-Frequency cepstrum coefficients technique that applied to the normal heart sound. This experiment used feature vectors composed from 12 lowest Mel-frequency cepstral coefficients (MFCC) computed using about 27 mel-spaced filters. The 0th coefficient was excluded because it carries a little of signal specific information. Analysis frame was windowed by Hamming window with some overlapping.

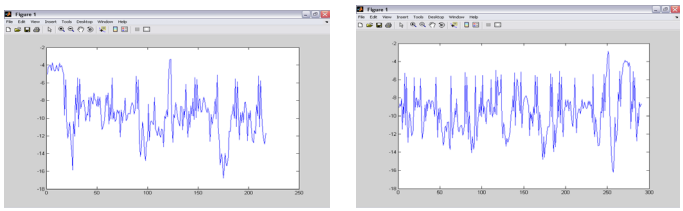


Figure 6. MFCC of Normal Heart Sound

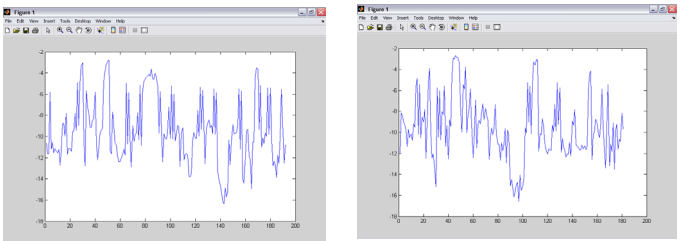


Figure 7. MFCC of Abnormal Heart Sound

Fig. 7 is the results analysis of the abnormal heart sound using MFCC. Fig. 7 is an example of the abnormality caused by mitral regurgitation and aortic regurgitation

RESULT

The task of heart diagnostic system is to verify normal pattern from the abnormal. Fig. 8 and Fig. 9 show the verification results of normal and abnormal heart sounds after feature extraction using TFD and MFCC. The minimum error, E_{min} is set to be as small as possible which 0.01.

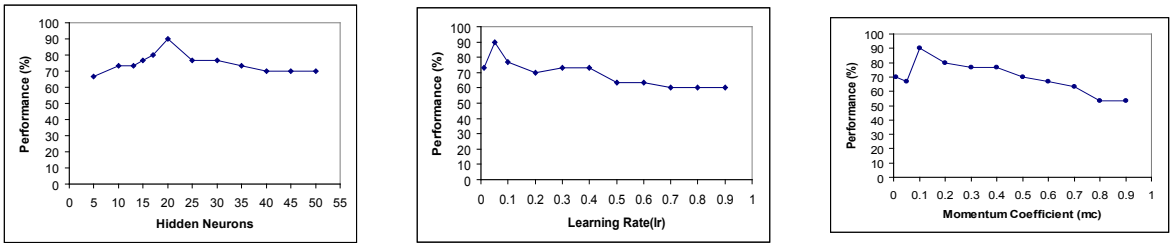


Figure 8. Verification of TFD. (a) Number of Hidden Nodes, (b) number of learning rate and (c) momentum term

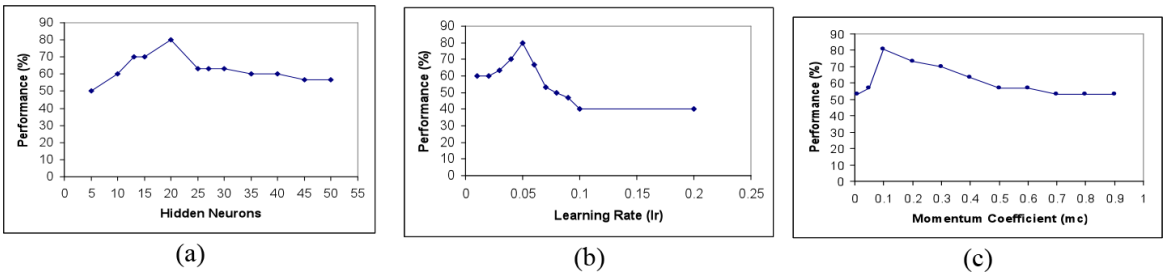


Figure 9. Verification of MFCC. (a) Number of Hidden Nodes, (b) number of learning rate and (c) momentum term

An initial experiment was conducted to investigate the effects of different values of learning rate and momentum term. The network weights were initialized with value between -3 and 3. The experiments were evaluated with the dataset of 19 normal patient and 42 abnormal. Several experiments were conducted to determine the number of hidden nodes for this task. The numbers of hidden node set in these experiments were varied from 4 to 25. Beginning with 4 hidden nodes, the number was increased by 5 until 50 hidden nodes. All experiments show an increase of accuracy to a certain point and start to decrease with the increase if hidden nodes. Using the back-propagation algorithm, the network was trained with a fix learning rate of 0.5, 0.25 and 0.5 and a fix momentum term of 0.1, 0.65 and 0.9, the result is shown in Fig. 8 and Fig. 9.

The performance of neural network model with different features is evaluated on the test data. Table 1 shows the results of verification technique using TFD and MFCC. They showed that the highest performance they can be achieved is up to 96.1% at hidden nodes = 20, learning rate = 0.05 and momentum coefficient = 0.1. MFCC can only achieve up to 80% of accuracy at hidden nodes of 20, learning rate of 0.05 and momentum coefficient of 0.1.

Table I. Feature Extractor Performance

	Time Frequency	**MFCC**
Input for Training	256x50	345x50
Input for Testing	256x50	345x50
Hidden Layer	20	20
Learning Rate	0.05	0.05
Momentum Term	0.1	0.1
Performance	96.6%	80.0%

CONCLUSION

The main goal of this work is to describe methods that can be used to represent heart sound features, which are either decomposition based approach using TFD or translation based using MFCC. The neural network is used to measure each performance. This paper has shown that the use of TFD and NN provide a more optimum solution for the heart diagnostic system. The TFD can provide the information that represents the heart sound and murmurs in the most intensive manner. The time variations, frequency variations as well the energy variations are preserved. These are the most important signal characteristic need to be included when analyzing non-stationary signals.

ACKNOWLEDGMENT

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Kamarulafizam, *Sh Hussain, Salleh, Arief. A. Harris, K. Yusoff, AliasM.
Noor, Hadrina Sh-Hussain & A.S. Rahmani
[1]*Centre for Biomedical Engineering, Universiti Teknologi Malaysia*
[2]*Faculty of Medicine, Universiti Teknologi MARA*
*kamarulafizam@yahoo.com, *hussain@fke.utm.my*

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A Review of Design and Analysis for Bearingless Permanent Magnet Synchronous Motor

Normaisharah Mamat, Kasrul Abdul Karim &
Zulkiflie Ibrahim

ABSTRACT

Bearingless permanent magnet synchronous motor (BPMSM) is the combination of characteristics of conventional permanent magnet synchronous motor and magnetic bearings. The paper presented the description of BPMSM including the principle of radial suspension force, mathematical model, vector control and FEM prototype for BPMSM. The mathematical model of radial forces thatarededuces by using the principle of producing radial suspension forces. The relation algorithm between bearingless suspension forces, motoring torque and other parameter such as current and voltage are identified. The purpose of the algorithm is to achieve a stable bearingless forces and motoring torque. After analyzing the mathematical formula, the modelling of motor is create by using Finite Element Method (FEM). Finally an experimental system control diagram and some test results are discussed.Various applications can be used using BPMSM especially with high speed electrical machine such as compressor, turbines, pumps, motor and generator.

Keywords - bearingless permanent magnet synchronous motor (BPMSM), mathematics model, radial suspension force, FEM

ABSTRAK

Magnet kekal motor segeraktanpa galas (BPMSM) adalah gabungan antara magnet kekal motor segerak konvensional dengan galas magnet. Kertas ini membentangkan perihal BPMSM termasuk prinsip kuasa penggantungan jejarian, model matematik, kawalan vector dan FEM model untuk BPMSM. Model matematik daya jejarian yang disimpulkan dengan menggunakan prinsip menghasilkan kuasa penggantungan jejarian. Hubungan algoritma antara kuasa penggantungan tanpa galas, tork permotoran dan parameter lain seperti arusdanvoltan di kenalpasti. Tujuan algoritma adalah untuk mencapai kuasa apungan yang stabil dan tork permotoran. Selepas menganalisis persa maan matematik, model motor dibina dan simulasi digunakan dengan menggunakan perisisan kaedah elemen finit (FEM). Akhirnya, sistem kawalan tanpa galas dan beberapa keputusan eksperimen dibincangkan. Pelbagai aplikasi berpotensi yang sesuai untuk BPMSM terutamanya melibatkan mesin elektrik kelajuan tinggi seperti pemampat, turbin, pam, motor dan penjana.

Kata kunci – magnet kekal motor segeraktanpa galas (BPMSM), model matematik, kuasa penggantungan jejarian, FEM.

INTRODUCTION

A magnetic bearing is a machine element that utilizes a magnetic levitation force to suspend a rotor without any mechanical contact. It has been applied to high speed motor such as machine tools and turbo-molecular due to many of the advantages which is no mechanical contact, no lubrication and no wear. However, motors with magnetic bearings require long axial shaft length because of the size magnetic bearing are large and arranged in the both ends of the motor. These problems will cause the critical speeds are decrease and resulting the difficulties in increasing rotational speeds. To overcome this solution is by using bearingless motor [1].

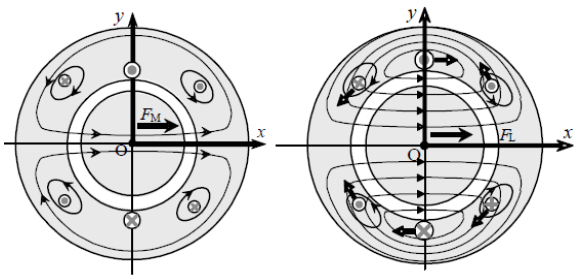
Bearingless motor was used for the first time by R. Bosch in 1988. Bearingless motor does not mean the lack of bearing forces but it means of the missing of physical contact bearing components. The principle of bearingless motor is based on the contactless magnetic bearing of the rotor [2]. The bearingless motor have beenapplied in many types of motors such as bearinglessinduction motor, bearingless reluctance motors, bearingless permanent magnet synchronous motor and bearingless slice motor [2], [3]. The advantages of bearingless permanent magnet synchronous motor (BPMSM) compare to the others motor is because of the small size and light weight, high power factor and high motor efficiency, and magnetic suspension without exciting current [3]. The research on BPMSM based on paper [4]-[9] is mostly used surface mount permanent magnet. However the research on buried and internal BPMSM is also studied based on paper in [10], [11]. The paper [11] compared between the different structures of rotor inbearingless motor and the result is the surface mounted permanent magnet is preferred compare to the others because of ideal operation condition with uniform air gap. Based on the comparison between the other rotor structure for levitation forces and electromagnetic torque of bearingless forces, surface mount PM rotor has the largest torque and larger levitation force.

The goal of this paper is to review on the details of bearingless motor, the general description for the radial suspension force principle, the mathematical model of BPMSM, and the control diagram system and Finite Element Method (FEM) analysis for prototype motor. This paper is organized with suspension principle of bearingless PMSM in section II. This part shows on how the torque and radial suspension force is generated. In Section III, the mathematical model that involve in BPMSM is derive and discuss. The algorithm is important to make sure the rotor suspend in center position and stabilize. Section IV shows the digital control system for BPMSM on how the algorithm is applied in block diagram. The last part is Section V, FEM analysis for prototype motor which isusing ANSYS software in designing the motor.

SUSPENSION PRINCIPLE OF BERINGLESS PMSM

Bearingless motor can be realized by generate a controllable unbalance magnetic field which is in motor's air-gap. To make sure the rotor is suspend under the action of magnetic forces, the interaction of suspension force winding and torque winding with air-gap magnetic field must be generated. Based on the paper by Huangqiu Zhu [5], the generation of torque and suspension force at the same time is occur when woundedthe torque and suspension force winding together in the same stator slots. Considering the pole-pairs of torque windings and suspension force winding to be P_M and P_B, theories and practice all prove that when $P_B = P_M1$, a stable radial force in a single radial direction can be generated on the rotor. This met condition can possible for

the rotor suspend steadily. When the current excited in the two sets of windings, there are two type of magnetic force which is Lorentz force and Maxwell force. The same statements proposed in the paper [12]-[14] which is means that the suspension principle only occur when P_B=P_M*1*. By using the number of pole pairs for torque winding, P_M is 1 and number of pole pairs of suspension winding, P_B is 2, the forces acting in the rotor are shown in Figure 1. Maxwell force also known as magnetic resistance force is the forces marked on the rotor surface. Figure 1(a) shows that Maxwell force direction is horizontal rightward means that the radial force of rotor is acted in the horizontal rightwards direction. For Figure 1(b), the force is also acted on surface of the rotor. The Lorentz force acting on the torque winding and bearing winding and the direction is in counter forces which is making the radial force of rotor in the rightward direction. The condition of these two radial forces makes the rotor to suspend steadily in bearingless motor [12].



(a) Maxwell force (b) Lorentz force

Figure 1: Sketch of force in unbalanced magnetic field in BPMSM [12]

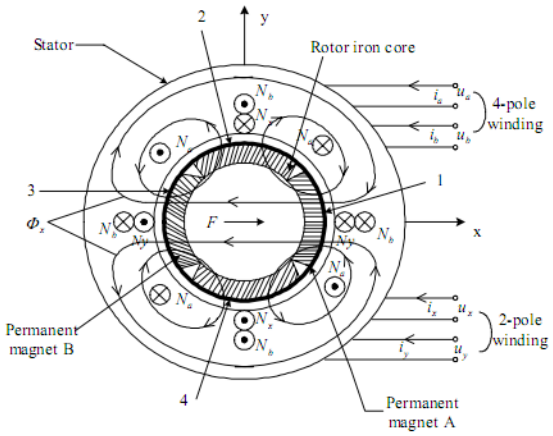


Figure 2: Principles of radial force production [6]

Based on the Figure 2, the torque winding is N_a and N_b with pole pairs of 2 and N_x and N_y which is suspension force winding with pole pairs of 1. When the rotor displacement at the center without current in N_x and N_y, the resulting of symmetrical 4 pole flux produced, flux density in each airgap is equal and no suspension force is produced. The displacement of rotor at negative direction on *x*-axis cause Maxwell-Force positive in *x*-axis is generated. To insure the rotor in balance position, the magnetic flux in 1 and 2 regulated. The current of suspension winding N_x in positive will cause the 2-pole flux is generated and flux density in airgap 2 increase and 1 is decrease. To make the rotor back to the central position, *x*-axis must be produced with negative direction. The same principle occur when the direction of rotor in negative x-axis which is can

cause the current of suspension winding become negative, thus flux density in air-gap 2 is decrease and air-gap 1 is increase. This concept is also use in controlling the current of the suspension force winding for N_y means that the current of N_x and N_y can be adjust for the direction and magnitude of radial forces. The same principle isdiscussed in paper [6] and [14].

MATHEMATICAL MODEL

Radial Suspension Force Mathematical Model

This part present the equations that are used in designing BPMSM based on the paper in [6], [7] and [15]. Firstly the inductance matrix of BPMSM is obtain by analyze the intersection of torque winding and suspension force winding between magnetic flux linkage such as in (3). Then by using the expression of electromagnetic energy and radial force, the complete equation for radial suspension force and suspension winding current is obtained. The torque winding and suspension force winding is the two sets of stator winding use in BPMSM including two basic functions which is producing electromagnetic torque and radial forces. The basic principle equations in designing BPMSM is

- Flux linkage equations of torque windings
- Flux linkage equations of suspension force windings
- Voltage equation of torque winding
- Voltage equation of suspension winding
- Electromagnetic torque equation
- Radial suspension force equation

Based on Figure 3, the diagram shows the rotating coordinate systems from stationary to synchronous system.-frame is known as stationary coordinate while *d-q* known as synchronous rotating coordinates.

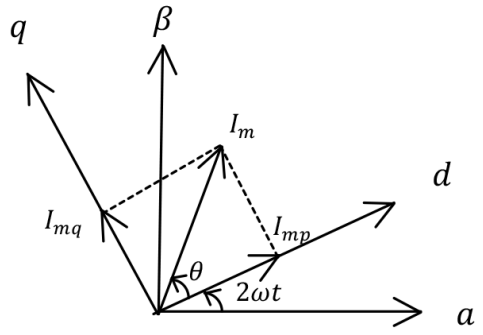


Figure 3: Stationary and synchronous rotating Coordinate system [7]

$$i_b = I_m sin(2\omega t + \theta) \tag{1}$$

Where,

$$I_m = \sqrt{I_{mp}^2 + I_{mq}^2} \; ; \; I_{mp}\sqrt{1 + \left(\frac{I_{mq}}{I_{mp}}\right)^2}$$

w = mechanical rotational angular speed

$$\theta = tan^{-1}\left(\frac{I_{mq}}{I_{mp}}\right)$$

I_{mp} = amplitude of equivalent currents by permanent magnets
I_{mq} = amplitude of equivalent torque currents in stator

In BPMSM, the radial forces on the rotor has three part

- Maxwell force acting on the rotor constitutes radial force in the motor's air-gap magnetic fields.
- Lorentz force acting on the current carrying bearing windings in the air-gap magnetic fields of bearing windings formed counterforce on the rotor.
- Lorentz force acting on the current carrying bearing windings in the air-gap magnetic field of driving windings, rotor eccentricity cause unbalanced distribution of air-gap magnetic fields that generate radial force.

Third radial forces is change as the variety of the extent of rotor's eccentricity cause the direct proportional relationship is equal in the *x* and *y* direction because of equality and symmetry of motor's air-gap magnetic field as describe in paper [5]. The expression for rotor's eccentricity caused radial force is

$$\begin{bmatrix} F_{cx} \\ F_{cy} \end{bmatrix} = \left[k_d (I_{PM} + i_{Md})^2 + k_q \left(i_{Mq}\right)^2\right] . \begin{bmatrix} x \\ y \end{bmatrix} \quad (2)$$

K^d and k^q = constant

The derivation of magnetic flux is linkage equation is by using the concept of mechanical to electrical coordinate transformation as present in paper [15]. Based on the paper, driving winding and bearing winding in electrical coordinate is in series electrical connection cause mutual inductance of the two bearing is zero when the line are perpendicular to each other. So, the relationship between flux linkage of the permanent magnet field excitation and q- axis winding current, the flux linkage is written as

$$\begin{bmatrix} \Psi_{\alpha} \\ \Psi_{\beta} \\ \Psi_{\alpha'} \\ \Psi_{\beta'} \end{bmatrix} = \quad (3)$$

Where,

$$M' = \frac{\pi \mu_0 n_4 n_2 l}{8} . \frac{r - (l_m + l_g)}{(l_m + l_g)^2} \quad (4)$$

l = length of rotor iron core
l_m = permanent magnet thickness
l_g = airgap length
μo = magnetic conductance of air

N_α *and* N_β such as shown in Figure 2 is define as flux linkage of Ψ_α and Ψ_β while N_x and N_y is define as Ψ_x and Ψ_y. L_m and L_b is self-inductance. *M'* is mutual inductance. i_α and i_β is refer to β-axis component and -axis component of suspension force windings. Mostly the paper on BPMSM[5],[6],[7] and [12] are using mutual inductance for bearingless motor equation becauseof the characteristic that change the current in one inductor causes a voltage drop to be induced in the other inductor and also can measured the coupling between two inductors.

The magnetic energy w_m stored in the windings can be written as

$$w_m =$$

$$= \frac{1}{2}\begin{bmatrix} i_\alpha \\ i_\beta \\ i_{\alpha'} \\ i_{\beta'} \end{bmatrix}^T \begin{bmatrix} L_M & 0 & M'x & -M'y \\ 0 & L_M & M'y & M'x \\ M'x & M'y & L_B & 0 \\ -M'y & M'x & 0 & L_B \end{bmatrix} \begin{bmatrix} i_\alpha \\ i_\beta \\ i_{\alpha'} \\ i_{\beta'} \end{bmatrix} \tag{5}$$

$$= \frac{1}{2}[i_\alpha\left(L_m i_\alpha + M'x i_\alpha - M'y i_{\beta'}\right) +$$

$$i_\beta\left(L_M i_B + M'y i_{\alpha'} + M'x i_{\beta'}\right) +$$

$$i_{\alpha'}\left(M'x i_\alpha + M'y i_\beta + L_B i_{\alpha'}\right) +$$

$$i_{\beta'}\left(-M'y i_\alpha + M'x i_\beta + L_\beta i_{\beta'}\right)]$$

$$= \frac{1}{2}L_m(i_\alpha^2 + i_\beta^2 + \frac{1}{2}L_B\left(i_{\alpha'}^2 + i_{\beta'}^2\right) +$$

$$M'x\left(i_\alpha i_{\alpha'} + i_\beta i_{\beta'}\right) + M'y(-i_\alpha i_{\beta'} +$$

$$i_\beta i_{\alpha'})$$

Based from the expression derive in (5), so the radial force in F_x and F_y can be express in *x-y* direction as shown in equation (6).

$$\begin{bmatrix} F_x \\ F_y \end{bmatrix} = \begin{bmatrix} \frac{\delta W_m}{\delta x} \\ \frac{\delta W_m}{\delta y} \end{bmatrix} = M' \begin{bmatrix} i_\alpha i_{\alpha'} + i_\beta i_{\beta'} \\ -i_\alpha i_{\beta'} + i_\beta i_{\alpha'} \end{bmatrix} \tag{6}$$

$$= M' \begin{bmatrix} i_\alpha & i_{\beta'} \\ i_\beta & -i_\alpha \end{bmatrix} \cdot \begin{bmatrix} i_{\alpha'} \\ i_{\beta'} \end{bmatrix}$$

All the equation in (1), (3), and (5) are substitute into the equation (6). The resulting is shown in equation (7). This equation is shows the relationship between radial suspension force and suspension winding current.

$$\begin{bmatrix} F_{mx} \\ F_{my} \end{bmatrix} = M' I_m \begin{bmatrix} \cos(2\omega t + \theta) & \sin(2\omega t + \theta) \\ \sin(2\omega t + \theta) & -\cos(2\omega t + \theta) \end{bmatrix} \begin{bmatrix} i_{\alpha'} \\ i_{\beta'} \end{bmatrix} \tag{7}$$

For vector control of suspension force winding's current, Park inverse transform is adopted written as

$$\begin{bmatrix} i_{a'} \\ i_{\beta'} \end{bmatrix} = \begin{bmatrix} \cos(2\omega t + \theta) & -\sin(2\omega t + \theta) \\ \sin(2\omega t + \theta) & \cos(2\omega t + \theta) \end{bmatrix} \begin{bmatrix} i_{Bd} \\ i_{Bq} \end{bmatrix} \tag{8}$$

i_{bd} an i_{bq} = current component of suspension force winding in *d*-axis and *q*-axis.

The equation (8) is substitute in equation (7) and resulting such in expression in (9).

$$\begin{bmatrix} F_{mx} \\ F_{my} \end{bmatrix} = M' I_m \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} . \begin{bmatrix} i_{Bd} \\ -i_{Bq} \end{bmatrix} = M' I_m \begin{bmatrix} i_{Bd} \\ -i_{Bq} \end{bmatrix} \tag{9}$$

where,

$$I_m = \sqrt{{i_{mp}}^2 + {i_{mq}}^2} = \sqrt{(I_{PM} + i_{Md})^2 + {i_{Mq}}^2}$$

I_{pM}= equivalent current component of torque winding.

By combining the equation in (2) and (8), the complete radial force equatiojn of BPMSM is obtained such as shown is (9). The value of and are constant.

$$\begin{bmatrix} F_x \\ F_y \end{bmatrix} = M' \sqrt{(I_{PM} + i_{Md})^2 + {i_{Mq}}^2} . \begin{bmatrix} i_{Bd} \\ -i_{Bq} \end{bmatrix} + \left[k_d \left(I_{PM} + i_{Mq} \right)^2 \right] . \begin{bmatrix} x \\ y \end{bmatrix} \tag{10}$$

The stator flux linkage equation

$$\Psi_d = L_d i_d + \Psi_r$$

$$\Psi_q = L_q i_q \tag{11}$$

Ψ_d and Ψ_q are airgap flux linkage
Ψ_r = coupling flux linkage which rotor magnetictractive in stator generates
L_d and L_q = self inductance of motor windings

The stator voltage equation is as follows

$$V_d = p\Psi_d - \omega\Psi_q + r_1 i_d$$

$$V_q = p\Psi_q + \omega\Psi_d + r_1 i_q \quad (12)$$

Electromagnetic Torque Mathematical Model

In bearingless PMSM, there are four part for Lorentz force. Namely, Lorentz force acting in torque winding which is current carrying torque windingand current carrying suspension force winding in airgap magnetic field. The other two is in suspension winding which is current carrying torque and fourth is current carrying suspension winding in magnetic field. The fourth Lorentz force is reluctance torque that generateelectromagnetic torquebut for surfacesurface mount PM, the reluctance torque is zero.So only the first part of Lorentz force is generateelectromagnetic torque of

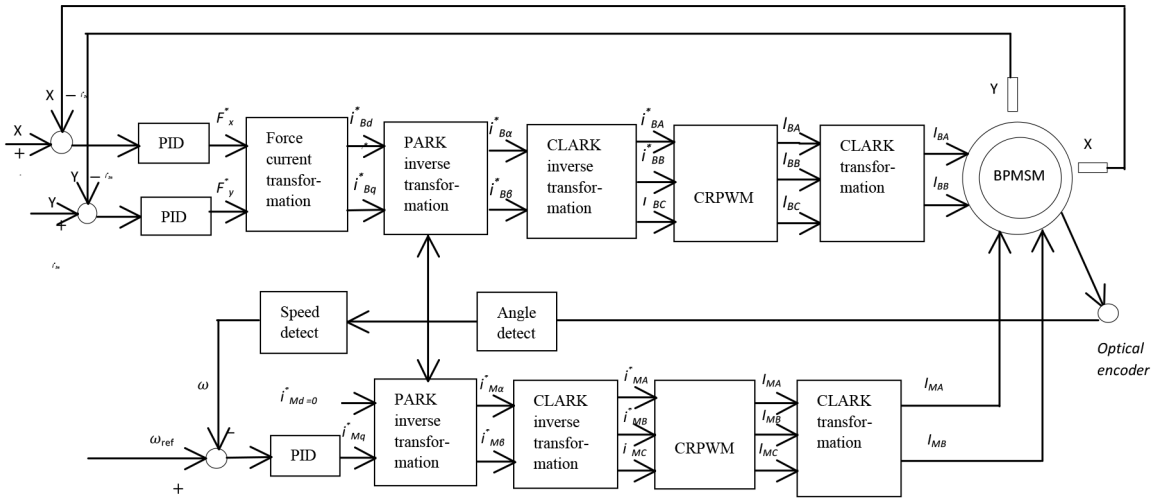


Figure 4: Digital control block diagram of BPMSM

BPMSM. The expression of the torque equation is same as general PMSM. The equation is express as

T_{em} = electromagnetic torque
J = moment of inertia
P_1 = pole pairs of torque winding

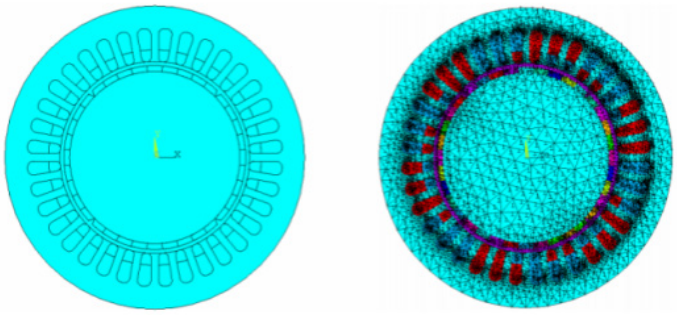
DIGITAL CONTROL SYSTEM

Digital control system for BPMSM is consisting of hardware and software. But this paper is only focus on software system. Based on the equation that derived from section (III), the block

diagram is build such as shown in Figure 4. The function of gap sensor is to detect the rotor radial displacement x and y in x- and y- directions. Meanwhile the function of proportional-integral-derivative (PID) controller is to amplified the difference between the detected displacement and command and. This is to make sure the radial suspension force and is correctly determined. To ensure the rotor radial positions command in center, the value of x and y is determine. Usually thevalue of x^* and y^* is set to 0. For the forcecurrent transformation's block, the equation (7) is use and simplified to obtain the value of and and transforming the coordinates. Then CLARK inverse transformations block changes from two phases to three phase system of suspension force windings. Finally, the current regulated pulse width modulated (CRPWM) change toand. The system is looping to realize radial suspending displacement and control theposition.is refer to command value of angular velocity and can operate when optical encoder's detection. Then the velocity PI adjuster is regulating the error between angular velocity and actual measured one so that the value of can be obtained. After the values of current command gothrough Park and Inverse transformation, the value is amplified by a three phase currents inverter so that three phase current i_{MA}, i_{MB}, i_{MC} can be obtained. These three phases current then are changes to two phase current by using CLARK transformation to matching with the motor that using two phase current. The system is looping to realize speed controller [15].

FEM ANALYSIS FOR PROTOTYPE MOTOR

Finite Element Method software is use in designing thismotor model based on the advantages which is can compute the rotational torque and suspension force. A prototype of permanent magnet bearingless motor by usingFEM is proposed in paper [16]. By using surface-mount permanent magnet, the authors preferred thin permanent magnet and small air-gap lengths to generate the radial forces. This is because the thickness of permanent magnet is one of the important aspects to be considered in designing the bearingless motor. The application of BPMSM by using FEM is shown in Figure 5 which is Figure 5 (a) is the model of BPMSM and Figure 5(b) is the mesh of BPMSM. The result obtained is the flux distribution for this type of motor is shows in [16] with the flux distribution with no current and flux distribution with radial force winding with supplying the current.



(a) Model (b) Mesh

Figure 5: Cross section of BPMSM (a) model of BPMSM (b) Mesh in BPMSM [16]

CONCLUSION

The paper provide an overview about the BPMSM based on the general description about bearingless motor which is the paper is focusing on surface mounted permanent magnet where the magnets are mounted on the rotor's surface. In addition, the paper is also present about the principle of radial suspension force, the mathematical model for motoring torque and suspension force, digital control system and finally FEM analysis for BPMSM.Two dimensional (2D) FEM analysis using ANSYS software is used in computing the rotational of torque and suspension force. In future, the modification for this type of motor is possible by using advance algorithm to design the motor and will increasethe number of application that are suitable for bearingless motor.

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Normaisharah Mamat, Kasrul Abdul Karim & Zulkiflie Ibrahim
Faculty of Electrical Engineering,
University Technical Malaysia Malacca (UTeM),
Hang Tuah Jaya,76100 Durian Tunggal,Malacca,Malaysia
Tel/Fax: 013-9184871; Email: nur_sara89@yahoo.com

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Behaviour of Precast Wall-Slab Connection using Grouted Splice Sleeve Subjected to Out of Plane Lateral Load

Nabila Rossley, Farah Nora Aznieta Abdul Aziz & Heng Chiang Chew

ABSTRACT

Rekabentuk sambungan memainkan peranan yang sangat penting dalam menetukan kejayaan struktur konkrit pratuang. Fungsi utama sambungan adalah memindahkan beban antara elemen-elemen pratuang konkrit. Pemahaman terhadap tingkah laku sambungan adalah penting dan hanya boleh dinilai dengan menjalankan ujian eksperimen. Objektif utama kajian ini adalah untuk menentukan hubungan anjakan-beban bersebelahan dinding untuk sambungan dinding pratuang bingkai dinding konkrit dan untuk mengkaji tingkah laku sambungan bar gelung dalam pratuang panel dinding. Untuk menentukan hubungan anjakan-beban dinding antara sambungan panel dan papak dan mengkaji tingkah laku sambungan lengan bagi panel pratuang struktur. Ujian ini terdiri daripada sejumlah enam skala penuh pratuang dinding spesimen papak. Dalam kajian ini, ujian makmal telah dijalankan untuk menilai tingkah laku hubungan ini dengan mengkaji hubungan beban-anjakan, hubungan beban-terikan dan jenis kegagalan kerana pemahaman kepada jenis ini struktur sambungan tidak diketahui. Daripada penyelidikan ini mendapati sambungan lengan hanya mampu menaggung beban mampatan. Ikatan menegak perlu disediakan untuk mengikat dinding atas dan dinding bahagian bawah untuk memastikan beban dapat dipindahkan dari atas ke bawah dinding

Keywords: Struktur pratuang, panel, papak, sambungan

INTRODUCTION

The introduction of precast concrete structural systems has shown advantages in concrete structure constructions such as, provides easy standardisation, cost saving, efficient use of materials, speedier construction and improved quality control (Megally et al., 2002). Although based on Survey on the Usage of Industrialised Building Systems (IBS) in Malaysian Construction Industry on 2003 shown that steel beams and columns is the most popular IBS types, but due to the cost, precast concrete construction has gained popularity with engineers and architects (Ahmad Baharudin et al, 2006). There are three types of precast building systems which are portal frame, skeletal structure, and wall frame (Ehsan Noroozinejad Farsangi, 2010). The last category of precast structure which is wall frame is chosen because it more economical compared than the other two types and increases the speed of the construction (Sidney, (1999) Shrikant And Ashok R (2012), T. Chan (2011), Kim. S Elliot, 2002).

RESEARCH OBJECTIVE

The main objectives of this research are as follows:

i. To determine the load-displacement relationship of wall to slab connection in precast concrete wall frame.
ii. To study the behaviour of grouted splice sleeve connection in precast wall panel.

RESEARCH SIGNIFICANCE

Design of connection plays an important role in successful of the precast concrete structure ((Loo and Yao (1995), Sadrnejad and Labibzadeh (2006), Patrick et al (2011)). The main function of the connection is transfer forces between the precast concrete elements. For this reason, it is important to not just design the connection by considering the anchorage tie bars but also selecting the appropriate size of precast elements. Many precast concrete components used as exterior walls do not have thick concrete cross sections. The minimum thickness of precast wall based on JKR Standard should be more than 150 mm. In this research, the thickness of precast wall just only 125 mm. The use of slimmer precast wall is acceptable provided that it is proven by lab test.

SPECIMEN DETAILING

The test consists of a total of six full scale of precast wall slab specimens. Wall slab joints can be isolated from the points of contra flexure. The slab is taken to the mid-span, while the wall is taken from the mid-height of one storey to the mid-height of the next storey. The height, width and thickness of wall panel are 1500 mm, 1000 mm and 125 mm. Meanwhile, the length, width and thickness of the slab are 1700 mm, 1000 mm and 130 mm. High yield BRC of grade N/mm^2 has been used as the replacement of reinforcement bars in precast walls and slab. The half slab consists of 65 mm reinforced precast plank and 65 mm in situ topping. Type of connection used was grouted splice sleeve with starter bar protrude from one precast member and inserted into pipe sleeves that are cast into another using a non shrink grout. For further details, the illustrations of all specimens are as shown in Figure 1 until 3.

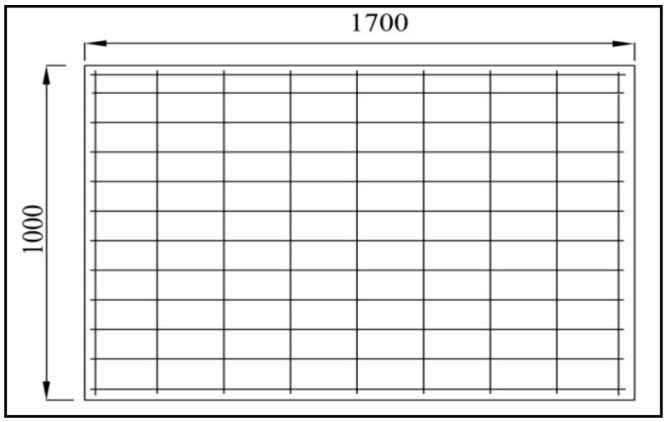

Figure 1: Detailing of slab

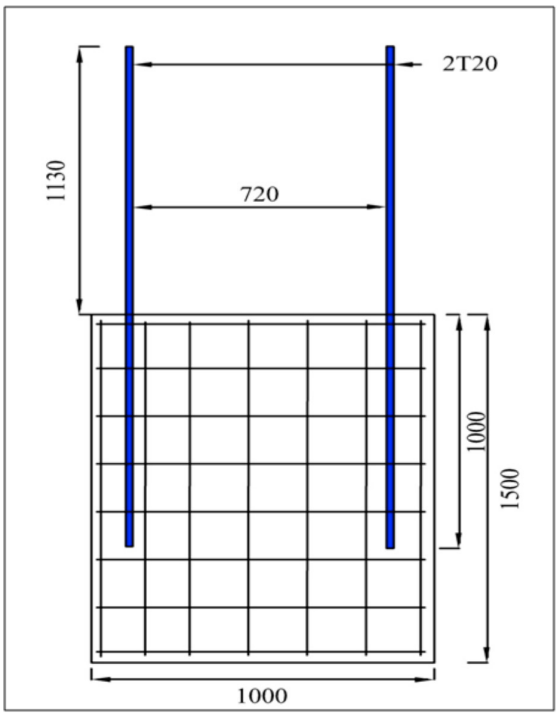

Figure 2: Detailing of top wall

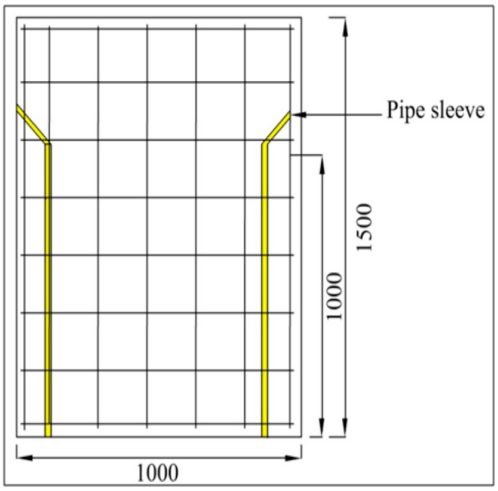

Figure 3: Detailing of bottom wall

TEST SETUP

A total of six specimens were tested in this experimental program. The test set-up are shown in Figure 4 and 5. The wall is fixed at the bottom. The ends of the slab were supported by rollers that allowed free horizontal movement and rotation to simulate lateral drift. The load is applied along the length of top wall. Five LVDT are placed along the length of the wall, which is used to measure the displacement of the wall. All instrumentations are attached to data logger to record the load applied and displacement. In this test, the load was applied up to failure of the specimens or when the maximum stroke of the actuator was reached. Three specimens were tested without steel beam, while the other three specimens with the steel beam placed on the top wall. The main reason the steel beam placed on the top wall was to make the top wall fix.

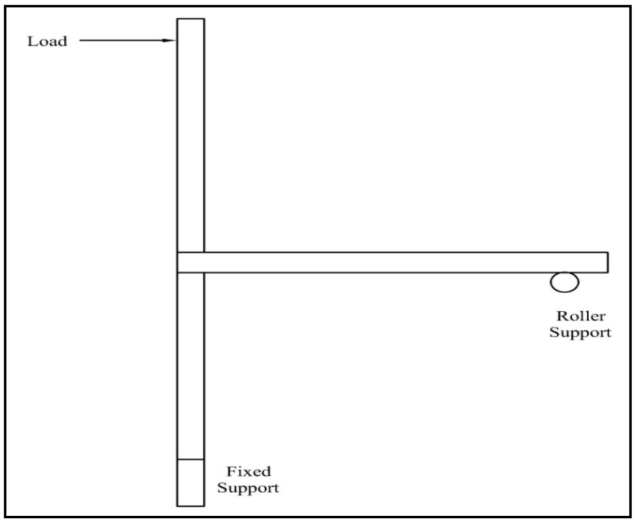

Figure 4: Test setup of wall-slab connection

a) b)

Figure 5: Test setup of wall-slab test, a) without steel beam b) steel beam placed on the top wall

RESULT

In this paper the behaviour of slab-wall connection specimens which are tested with and without steel beam placed on the top wall is discussed. Based on three specimens, a typical behaviour of one of the sample is shown in Figure 6. The displacement of the wall is consistent through its length. As shown in Figure 6, LVDT 1 which is placed at the top of the wall i.e closes to the applied load shows largest displacement as compare to LVDT 5 which is placed at the bottom of the wall i.e. the nearest to the support. This shows that along the test, the connection give sufficient bond to allow the two walls to move as one unit.

Near to failure, the movement of the spliced bars was noticed that may cause by bond failure of the interface between top wall and slab. The starter bar lost its grip in the grout by shear failure that occurs along the interface between the top wall and slab. This type of failure mode is called pullout failure. This shows that the interface interaction developed in the pipe sleeve is insufficient which could be due to weak bond between grout to steel or grout to pipe sleeve. The maximum load obtained from the lab test shows that the connection only able to transfer compression and this bar can only be used for positioning (Structural Connection for Precast Concrete Building, 2008). Other than that, small thickness of the wall may have caused insufficient dowel action between the sleeve and wall, hence the maximum capacity of the joint cannot be reached. The test was terminated when the stroke of the actuator reached its maximum displacement which is about 150mm, at that time the cracks along the joint are obvious and sufficient to show the capacity of the connection but not the maximum capacity of it.

The other three specimens were tested with an intention to create the fix end at the top of the wall i.e. at the applied load as shown in Figure 5b. The load displacement relationship of one of the sample is shown in Figure 6. The two LVDT at the top wall i.e LVDT 1-2 have larger displacement then the three LVDT at the bottom wall i.e LVDT 3-5. This result shows by putting I steel beam of about 100ton weight at the top of the wall, it already considered as applied gravity load on to the wall, that then being transferred to the top wall. However the connection could not transfer the load to the bottom wall as the lateral load is applied; hence larger displacement was measured

on the top wall as compared to the bottom wall. Therefore, the failure load obtained shows not much different in terms of maximum capacity for both samples with different test procedures.

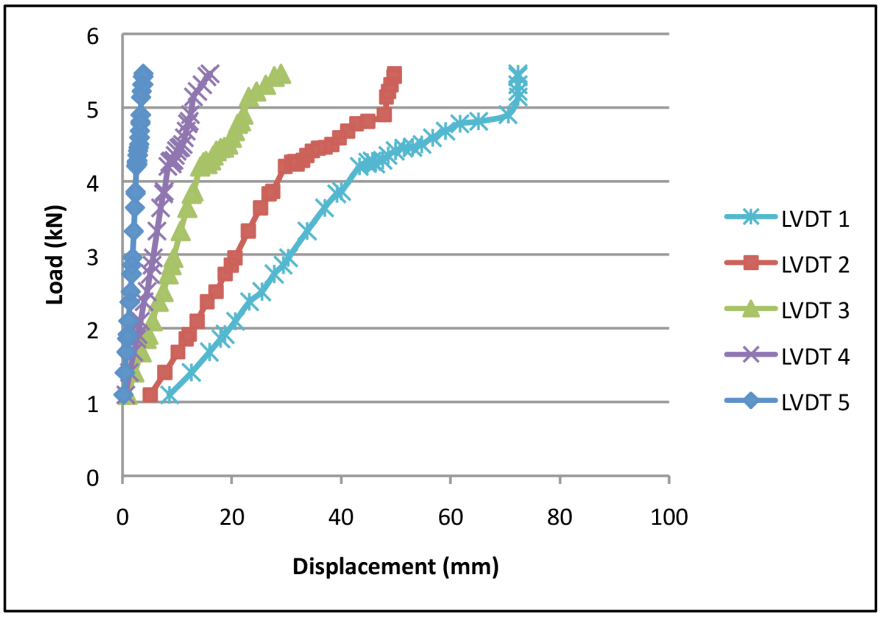

Figure 6: Specimen Load-displacement relationship based on Test Set-up 1

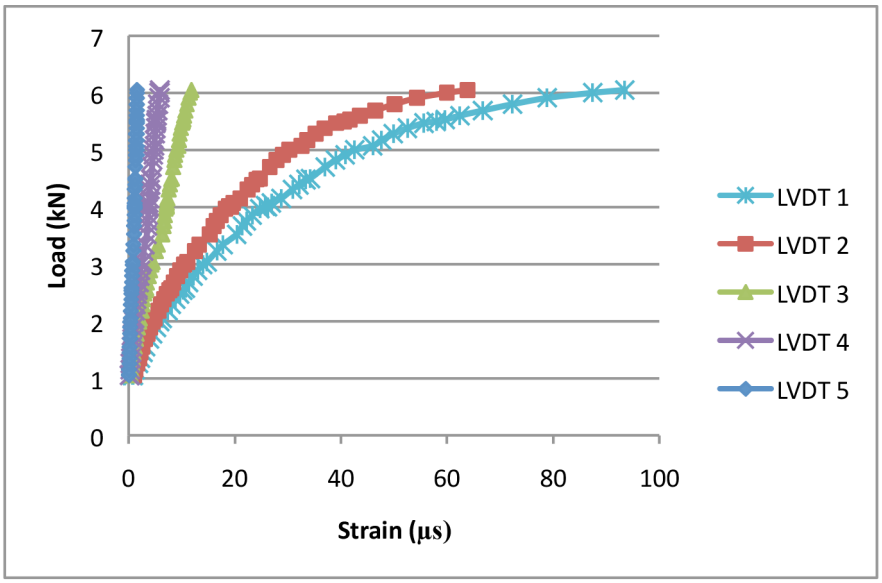

Figure 7: Specimen Load-displacement relationship based on Test Set-up 2

CONCLUSION

Based on the test results, the following conclusions can be drawn:

1. Grouted splice sleeve connection only able to transfer compression and protruding bar only can be used for positioning.
2. Vertical ties should be provided to tie the upper wall to the bottom wall to ensure the load able to be transferred from the top to the bottom wall.

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Nabila Rossley
Email address: nabila88888@gmail.com
Contact No: 013-2646224

Farah Nora Aznieta Abdul Aziz
Email address: farah@eng.upm.edu.my
Contact No: 012-7020786

Heng Chiang Chew
Email address: lawrrence@baxtium.com
Contact No: 03-5882 3349

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The Effectiveness of Stand Alone Toxin Removal Machine

Nurul Syuhada Mohamad, Mohd. Hudzari Razali
& Nashriyah Mat

ABSTRACT

Dioscorea hispida Dennts is a tubers that highly toxic and can only be eaten after the elimination of toxins. Development of Stand Alone Toxin Removal Machine is used to removal the toxin, which is Discorin in the tuber by using modern method. Previously, the tuber is washed by using traditional method, the slice tuber will be soaked in the rivers that have flowing water for 7 days. Stand Alone Toxin Removal Machine is moving continuously by circulation of water. The tuber will go process for 4 hour and 7 hour to removal the toxin. The tuber maybe easily rubbed against each other during water circulation and thus make the toxin removal faster out from tuber. This machine will be reduced the time for toxin removal. The survival rate of *Cyprinus carpio* fish in the waste water of *Dioscorea hispida* is determined, the fish is allow to move freely in the waste water for 6 hours or more than that.

Keywords: Stand Alone Toxin Removal Machine, *Dioscorea hispida*, Toxin and Discorin

INTRODUCTION

This study which is entitled as the Effectiveness a Stand Alone Toxin Removal Machine will focus towards the removal of toxin in the *Dioscorea hispida Dennts*. *Dioscorea hispida* that is also known as 'ubi gadong' has a large underground tubers that have fibrous roots. The tubers are produced near the soil surface and are extremely poisonous, due to alkaloid that is known as toxin. It has twining vine, arising from tuberous roots, and reach a length of several meters. Stems are covered with few or many short, sharp spines. Fruit is a capsule, oblong and about 5 cm long. Flesh and sap of tubers are yellowish. As we know, *Dioscorea hispida* is a poisonous plant, the tuber of this plant contains toxic poison and it can only be consumed and eat after the toxin is removed (Mohd Rizuwan *et al*., 2013).

This Stand Alone Toxin Removal Machine is used to replace and reduce the human work in the production, operating by circulation of water and fully automated. This machine has been improved, to increase the effectiveness in order to get a better result during operation. The tubers need to be sliced into small pieces before wash by flowing water using this machine, the circulation of water plays important role in the operation. The time also will be reduced by using this machine. The tuber maybe easily rubbed against each other during water circulation and thus make the toxin removal faster out from tuber.

The automation systems were used to control the system operation during the washing of tuber. The light sensor and ultrasonic sensor were included in detecting the intensity and the

water level. Light sensor is for detecting the intensity of water; it can read the light intensity in a room and measure the intensity of cloudy surface. Ultrasonic sensor also can be used to detect the water level in the machine, once the level of water is achieved at the distance that have been set up, this sensor can measure the distance in centimeters. The principle of this sensor is, it measure the distance by calculating the time it takes for a sound wave. The main component is NXT Intelligent Brick microcontroller, this component is used to take the input from sensor and control up. Timer controller is important to make sure of the suitable timer for water removal and renewal (Bagnall, 2007).

After running the machine, the water qualities of toxin waste were measured by using the water quality checker to measure its effectiveness. Water quality is referring to the biological characteristic, physical and chemical properties. Physical parameters commonly measured water quality is temperature, pH, conductivity and dissolved oxygen. We were use natural tap water as a control to compare with the water quality of *Dioscorea hispida* waste water. We also were testing the toxicity of waste water of the tuber by using *Cyprinus carpio* fish, to know the survival result of that fish after the toxin is removing (Hudzari et al., 2011).

Analysis of variance (ANOVA) is a collection of statistical models used to analyze the differences between group means and their associated procedures, in which the observed variance in a particular variable is partitioned into components attributable to different sources of variation. In its simplest form, ANOVA provides a statistical test of whether or not the means of several groups are all equal, and therefore generalizes *t*-test to more than two groups. Doing multiple two-sample t-tests would result in an increased chance of committing a type I error. For this reason, ANOVAs are useful in comparing (testing) three, or more means (groups or variables) for statistical significance (Andrew., 2008)

Problem statement

Dioscorea hispida is a poisonous tuberous plant, so there is a need to remove the toxin before consuming it as a food. The quantity of water and the time that is needed for the toxin removal is unknown, so we need to test the effectiveness of this machine.

There is also a need to develop a machine for replacing traditional method of removing toxin from *Dioscorea hispida tuber*. Besides, in Terengganu state no such machine, so, we can commercialize the removal machine for people there to use there is toxin is poison that can kill and is very harmful to people. Traditional way is usually by soaking the tuber in the sea or the flowing river for few days but with this machine it is hope that we can reduce its time of operation as well as the cost of worker if compared to the traditional ways.

For my study, I would like to measure the efficiency of this machine on removing the toxin of the tuber by using water quality checker. This machine also can be useful as a learning tool for educating the students in farm mechanization subject. The toxicity of the waste water will be ascertained by testing the *Cyprinus carpio* fish survival rate.

Objective of study

i. To measure the efficiency of stand alone toxin removal machine by using water quality checker.
ii. To measure the water quantity and the time required for removing the toxin in *Dioscorea hispida*.

iii. To measure the toxin removal in waste water *of Dioscorea hispida* tuber by survival rate of *Cyprinus carpio* fish.
iv. To develop the instruction standard operating procedure of toxin removal machine.

Significant of study

By the presence of stand-alone toxin removal machine, there will be more knowledge in the future on how to remove the toxin with better efficiency in a short time that will also reduce cost of hired worker. With specific specifications, it can easily be used by student or other people for commercial production of *Dioscorea hispida* in food industry.

It also has many advantages such as can production at a big capacity, high efficiency, usage of water can be reduce, the machine can automatically working continuously, easy and simple to operate, user friendly and with long life. The containers are made from special material and can prevent water leaking. This machine will use advanced technology designs, which can greatly which extend container, strainer and water pump life, and it can also reduce the maintenance frequency and mechanical life for many years longer. During the process of cleaning and toxin removal, the breakage rate is almost zero; thus the tuber can be maintained in good condition. During the washing and cleaning process, the water circulation principle and revolution can increase the touching frequency of the tuber. It can make tuber to rub with each other, and continuous water flow can easily reduce the toxin content in short time.

Besides, there is no attractive study material for toxin removal machine that has been published in the internet or web site especially about the toxin removal. So, with this machine it can be used for this study as an alternative for this matter. This machine will be useful for student to know better about the way to remove the toxin and how to use this machine. The existence of this machine will be more helpful to the all students in agricultural field when the standard of procedure is published. So, the information about the stand alone toxin removal machine will be displayed so that the students and peoples can get the information about that.

LITERATURE REVIEW

Fruit/Potato Washing Machine

Prior to processing the fruits and vegetables are washed and rinsed by means of flumes, soak tanks, water sprays, flotation chambers, or any combination of these methods. Great quantities of water are used. Detergents and ultrasonic techniques are also being tested for increased cleaning efficiency. Blanching is accomplished by putting the products in contact with water or steam. In almost all cases for preparation of vegetables to be frozen, it is imperative that the blancher processes be terminated quickly. Consequently, some type of cooling treatment is used. Typically, if the product has been water blanched, the vegetable is passed over a dewatering screen and cooled either by cold water flumes or cold water sprays. Product to be canned is usually not cooled after blanching. The pollution loads from blanching are a significant portion of the total pollution load in the effluent stream during the processing of certain vegetables (Carawan *et al*., 1979).

The system of washing represented in the product brushed and displaced by the moving brush until arriving to dryer sheet. The discharged out, so the foreign materials are removed from the surface of the product or dissolving in discharged water. The water discharged after washing

through the filter that removes the suspended materials from the water. The cleaned water pumped to the washing machine outlets. The turbidity measuring device used is Japan Model. HORIBA with High sensitive turbidity sensor ranged between 0 and 1,000 NTUs (Nephelometric Turbidity Units) will be used to check water quality (AI-Katary *et al*., 2010)

The process of potato washing on vibrating devices of continuous action, develop and produced at the department of equipment of working chamber. The reblanching vibro – stimulator with automatics regulator is used as an actuator. High speeds shooting that make the tuber moved circulatory. With the increasing the vibration intensity, the tuber adhesion decrease and they begin to lose the contact with the vibrating working chamber, potato loosening and intensive circulation take place, it favor qualitative washing. The speed of tubers movement in the washer was determined by means of measurement of time during which the marked tubers passed the working chamber (Antropova *et al*., 2009).

Discorine removal system is a machine that used to remove the discorine with the water. It is a simple machine with two tanks which the upper tank used to hold ubi gadong and water and lower tank consist of water pump. The discorine removal system is depends on the electrical power supplier to function. Discorine removal machine is a machine that included several electronic components for automation to remove the discorine found in ubi gadong which is toxic. The sensors play an important role in manages the input and output source. Controller with timer is also important in manage the timing when water will be renewed and removed. Water pump provides water force which will cause the rotation of water. A few modifications may help improve the machine to operate more efficiently (Hudzari *et al*., 2011).

Sensor

Optical sensors are designed in many ways to detect light scattering and attenuation in order to measure sediment and turbidity in water samples. A water sample, the red-shaded region, is illuminated by a light source, shown by the red light bulb, and one or more photo detectors convert the light radiated from the sample to photo current. The amount of photo current depends mainly on the area of the illuminated particles but also on particle size, shape and reflectivity. Since the area of the illuminated particles is directly proportional to the suspended solids concentration, measurements of light scattering provide a way to estimate. Light absorption by the sample will also affect the photo detectors and the indicated turbidity of the water (Downing, 2008).

Turbidity

Instantaneous water quality measurements include any measurements taken by field instruments, such as single- or multi-parameter probes. Data are recorded on a field sheet, discharge measurement sheet, or habitat assessment sheet. In-situ water quality parameters may include water temperature, pH, dissolved oxygen, specific conductivity, turbidity and percent oxygen saturation (Tabor *et al*., 2009)

Turbidity is an optical property of water that causes light to be scattered and absorbed rather than transmitted in straight line through the sample. It is caused by the molecules of water itself, dissolved substance, organic and inorganic suspended matter. Devices commonly used to measure turbidity include the Jackson candle turbidimeter, absorptimeters, transmissometers and nephelometers (McCarthy *et al*., 1974)

Detoxification

The traditional method used is peel the tuber skin and slice into small pieces. Firstly, the toxic compound in the tuber is removed by using ash absorbance. After that the tuber is soaked in water for a few hours that is 2 hour, 4 hour or 6 hour. The blanching is can reduce the quantity of discorine in tuber, the solution used to soaked the tuber is Ca (OH)2 0.3 % for 6 hour and the discorine content were analyzed (Djaafar *et al*., 2009)

The best accounts of detoxification *of D. hispida* are given by Ochse and van den Brink. One method is to cut the tubers in pieces, cover the surface with wood ashes for 24 hours, and then steep them in seawater for several days. The pieces are then washed with freshwater and dried. (Martin *et al*., 1978)

The survival of *Cyprinus carpio* fish in *D.hispida* slices tuber by different dioscorine removal equipment. Increasing of fish survival will increase with the times of detoxified process. The result can be considered as a positive if the fish can survive more than 6 hours after ex-posure to the solution. This can be used as an indicator be-cause human digestion takes 4 hours after taken a meal. Fish survived with the time of the detoxified processes (Hudzari *et al*., 2011).

Dioscorea hispida

The common names of *Dioscorea hispida Dennst.* in Malaysia *include Gadog, Gadong, Gadong lilin, Gadung mabuk, Gadung, Ubi akas, Ubi arak, Taring pelanduk* and *Sulur gadung* (Nashriyah *et al.,* 2010).

Dioscorea hispida Dennst. which is called as *Ubi Gadong* in Malaysia is a poisonous plant where methodical studies have shown that its rhizome contains toxic poison. It can only be consumed as a food after the poison of dioscorine is removed. Approximately, over 600 *Dioscorea* species are consumed in various parts of the world (Agbo *et al*., 1995).

MATERIAL AND METHOD

Material

Toxin Removal Machine, *Dioscorea hispida Dennst.,* Water Quality Checker and Fish

Method

1. Cut the tuber into small pieces and soaked in the water that contains salt and tangerine for one night and wash them.
2. Put the tuber in the blender and add a little bit of water for easier to blend and blend it until crushed finely.

Figure 1: Blended tuber of *Dioscorea hispida*

3. Fill up the water in the plastic container about ¾ full with clean water and switch On the machine.

Figure 2: Stand Alone Toxin Removal Machine

4. Put the blended tuber in the machine. Place the special cloth for filter at the strainer before put the blended tuber to avoid the tuber move out.
5. Switch On the machine for circulate the water, the machine is run for 7 hours nonstop.

Figure 3: Circulation water

6. The sample of waste water is taken 1 liter every 20 minute for tested. About 21 samples are taken.

Figure 4: Collecting waste water

7. The waste water is measure by using water quality checker to measure several parameter such as pH, Conductivity(ms/cm), Turbidity, Dissolve oxygen(mg/L), Temperature(°C), Salinity (%), Intensity and Survival Rate.
8. Life fish is prepared to test the waste water to measure the survival rate.
9. The fish is release in the waste water and freely move in the waste water to measure the survival rate. The fish that can survive more than 6 hour is give good result.

Figure 5: Releasing the fish in waste water

10. The time for survival rate is recorded; the maximum time for the fish survive is set up for 6 hours.
11. After finished the experiment, the recorded data is reading and analyzed by using ANOVA.

RESULT AND DISCUSSION

The experiments that have done for measure the effectiveness of stand alone toxin removal machine are for four hours and seven hours. This machine is used to remove the toxin in the *Dioscores hispida* tuber. As we know, the tuber need to soaked in flow water to remove the toxin before consume. The tuber is cut into small pieces and blended into powdered before run the machine. The parameter that have used are pH, Conductivity(ms/cm), Turbidity, Dissolve oxygen(mg/L), Temperature(°C), Salinity (%), Intensity and Survival Time. For the first experiment the machine is run for four hours, there is show positive result for toxin removal. The parameter use are pH,

Conductivity(ms/cm), Turbidity, Dissolve oxygen(mg/L), Temperature(°C), Salinity (%), Intensity and Survival Rate. Before testing the waste water, the value of parameter for control water (tap water) is taken for pH the value is 5.3, conductivity is 0.6 ms/cm, turbidity is 18, dissolved oxygen is 0 mg/L, temperature is 27°C, salinity is also 0%, intensity is 53 and survival rate for fish is 360 minute, the fish can survive more than 360 minute. The parameters that have been used for four and seven hours running time are same.

The effectiveness of Stand Alone Toxin Removal

From the Table 1 below, we can see the differences between control water and waste water of the tuber. The waste water taken are from liter 1, 3, 5, 8, 11, 14, 16, 18, 20, 22, 24, 26, 28, 30, 33, 35, 36, 37, 38, 39 and 40. After run the machine for four hours, the result show positive result, the waste water were clear than before and the parameter also change according to increasing time. The parameter value of waste water is nearly or same the control water parameter. We assume the toxin is removal when the parameter of waste water is nearly or same with the control water value. After run the machine for four hour, the pH was change. For the first liter of waste water, the pH is about 3.8 only. After run without nonstop, the pH is increase to 6.0. For conductivity, it decreases to 1.1 from 6.8 whereas the control water conductivity is about 0.6. The temperature is same in every time include of control water. For dissolved oxygen and salinity it also decreases to 0 whereas the dissolve oxygen is -0.1 and salinity is 4.0.

Table 1: Data Analyze (4 Hours Running Time)

Time (mint)	Liter	pH	Cond. (ms/cm)	Turbidity	Do (mg/L)	Temp (°C)	Salinity (%)	Intensity	Survival Time
0	Control	5.3	0.6	18	0	27	0	53	360
6	1	3.7	7.8	99	-0.1	27	0.4	50	16
18	3	3.7	8.0	99	-0.1	27	0.5	50.333	14
30	6	3.7	8.8	99	-0.1	27	0.4	49	16
48	10	3.7	8.1	20	-0.1	27	0.4	48.333	16
66	13	3.8	6.7	17	-0.1	27	0.4	51	14
84	19	3.9	6.0	21	0	27	0.3	53	14
96	28	4.4	4.5	19	0	27	0.2	54	15
108	31	4.5	3.6	18	0	27	0.2	0	16
120	36	4.8	2.7	12	0	27	0.1	0	22
132	38	4.9	2.6	13	0	27	0.1	0	25
144	40	5.0	2.5	12	0	27	0.1	0	32
156	42	5.0	2.3	8	0	27	0.1	0	35
168	44	5.1	2.1	11	0	27	0.1	0	40
180	46	5.2	1.8	17	0	27	0.1	0	99
198	49	5.3	1.6	12	0	27	0.1	0	114
210	51	5.4	1.5	12	0	27	0.1	0	360
216	57	5.4	1.5	10	0	27	0.1	0	360
222	58	5.7	1.3	16	0	27	0.1	0	360
228	59	5.7	1.2	17	0	27	0.1	0	360
234	60	5.8	1.2	10	0	27	0.1	0	360
240	61	5.8	1.1	9	0	27	0.1	0	360

For the second experiment, refer to Table 2 below. The machine is run for 7 hours to remove the toxin in the tuber and the water quantities that move out from the machine is about 60 liters. To compare the parameter of waste water from the tuber, I also prepared the clean water that is tap water as a control same as previous experiment. The parameter use are pH, Conductivity(ms/cm), Turbidity, Dissolve oxygen(mg/L), Temperature(°C), Salinity (%), Intensity and Survival Rate. Before testing the waste water, the value of parameter for control water (tap water) is taken for pH the value is 5.3, conductivity is 0.6 ms/cm, turbidity is 18, dissolved oxygen is 0 mg/L, temperature is 27°C, salinity is also 0%, intensity is 53 and survival rate for fish is 360 minute, the fish can survive more than 360 minute. The waste water is taken randomly that is start from liter 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 49, 52, 55, 58 and 60 which is from 1 minute until 420 minute (7 hours). The fish start survives and show positive results (fish survival rate) on minute 280.

For the first waste water at 1 liter (minute of 20) the parameter value are taken for pH value is 3.8, conductivity is 7.2 ms/cm, turbidity is 18, dissolved oxygen is -0.1 mg/L, temperature is 27°C, salinity is 0.4%, intensity 58 and survival rate for fish is only 24 minute, after that the fish is death. At minute 280, that is at the waste water 40 liter, the fish start survive and the parameter shown that result. For pH is about 4.0, conductivity is 4.1 ms/cm, turbidity is 20, dissolved oxygen is 0 mg/L, temperature is 27°C, salinity is 0.2%, intensity is 48 and the survival rate is 360 minute and can survive more than that. For comparison with control water (tap water) pH is 5.3, for the first waste water shown the pH is 3.8 and for minute 280 the pH is 4.0.

Table 2: Data Analyze (7 Hours Running Time)

Time (mint)	Liter	pH	Cond. (ms/cm)	Turbidity	Do (mg/L)	Temp (°C)	Salinity (%)	Intensity	Survival Rate
0	0	5.3	0.6	18	0	27	0	53	360
20	1	3.8	7.2	18	-0.1	27	0.4	58	24
40	4	3.8	7.7	18	-0.1	27	0.4	56	25
60	7	3.7	8.5	18	-0.1	27	0.5	50	23
80	10	3.7	8.6	99	-0.1	27	0.5	52	37
100	13	3.7	8.5	99	-0.1	27	0.5	47	25
120	16	3.7	8.4	99	-0.1	27	0.5	46	24
140	19	3.7	8.4	99	-0.1	27	0.4	42	24
160	22	3.8	7.2	99	-0.1	27	0.4	0	32
180	25	3.8	6.5	99	-0.1	27	0.3	0	55
200	28	3.8	5.9	99	-0.1	27	0.3	0	80
220	31	3.9	5.5	99	-0.1	27	0.3	0	110
240	34	3.9	5.0	99	-0.1	27	0.3	48	140
260	37	3.9	4.6	99	0	27	0.2	51	160
280	40	4.0	4.1	20	0	27	0.2	48	360
300	43	4.0	3.8	19	0	27	0.2	47	360
320	46	4.1	3.3	99	0	27	0.2	45	360
340	49	4.3	2.2	17	0	27	0.1	50	360
360	52	4.5	1.7	99	0	27	0.1	0	360
380	55	4.7	1.2	99	0	27	0.1	0	360
400	58	5.0	0.8	10	0	27	0.1	48	360
420	60	6.0	0.5	18	0	27	0	51	360

Significance

For four hours, see the Table 3 below, the data is from ANOVA p value =0.0001 less than 0.05. That mean it is Significant.So there is a regression line. For the Coefficients test, there is only pH coefficient is significant because p-value=0.00085 less than 0.05. All others p-value is more than 0.05. This means that only pH variable contributes significantly to survival rate. It contributes significantly to survival rate.

All other variables do not contribute significantly to survival rate. If pH is changes there is significant change in survival rate. But if other variables are changed and pH is not changed, the survival rate only changes slightly. We also cannot use temperature because coefficient is zero.

Table 3: Significance Value for Four Hours

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-2399.2243	645.7757	-3.7152	0.0025	-3794.3380	-1004.11	-3794.338	-1004.111
pH	457.3282	106.183	4.3069	0.0008	227.9337	686.7227	227.9337	686.7226
Cond.(ms/cm)	39.1686	51.41557	0.7618	0.4597	-71.9079	150.2452	-71.9079	150.2452
Turbidity	-0.4884	0.933488	-0.5232	0.6096	-2.5050	1.5282	-2.5050	1.5282
Do(mg/L)	476.7881	1216.259	0.3920	0.7014	-2150.7786	3104.355	-2150.7787	3104.355
Salinity(%)	1001.9273	569.0169	1.7608	#NUM!	-227.3588	2231.213	-227.3589	2231.2135
Intensity	1.28707	1.919873	0.6703	0.5143	-2.8605	5.4347	-2.8605	5.4347

See the Table 3 below, from ANOVA p value =0.003 less than 0.05. That mean it is Significant. So there is a regression line. For the coefficient test, only conductivity is coefficient is significant because the p – value = 0.0169 less than 0.05. All other p – value is more than significant level that is 0.05. This mean that only conductivity variable contribute significantly to survival rate. All other variable do not contribute significantly to survival rate. If the conductivity is change there is significant change in survival rate, but if other variable are changed and conductivity not changed, the survival rate only change slightly.

Table 4: Significance Value for Seven Hours

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	607.5219	172.9037	3.5136	0.0038	233.9860	981.0578	233.9860	981.0578
pH	-38.6561	33.8516	-1.1419	0.2740	-111.7883	34.4759	-111.7883	34.4759
Cond.(ms/cm)	-50.1222	18.3109	-2.7372	0.0169	-89.6807	-10.5638	-89.6807	-10.5638
Turbidity	-0.2393	0.3135	-0.7633	0.4589	-0.9167	0.4380	-0.9167	0.4380
Do(mg/L)	1562.2251	488.2750	3.1994	0.0069	507.3709	2617.0792	507.3709	2617.0792
Temp(°C)	0	0	65535	#NUM!	0	0	0	0
Salinity (%)	327.9999	293.8567	1.116189	#NUM!	-306.8389	962.8388	-306.8389	962.8382
Intensity	-0.0827	0.6233	-0.1327	0.8964	-1.4294	1.2639	-1.4294	1.2639

Cyprinus carpio Survival Time

The waste water is tested by using the fish, which is *Cyprinus carpio*. For *Cyprinus carpio*, they naturally live in temperate climates in fresh or slightly brackish water with a pH of 6.5–9.0 and

salinity up to about 0.5% and temperatures of 3 to 35°C. The ideal temperature is 23 to 30°C, with spawning beginning at 17–18°C; they easily survive winter in a frozen-over pond, as long as some free water remains below the ice. Carp are able to tolerate water with very low oxygen levels, by gulping air at the surface (Freyhof and Kottelat, 2011). After run the machine 7 hours, the parameter result show same value of waste water and control water (tap water).

Water or solution with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline. The scale for pH is from 0 until 14, normal pH is 7. At 420 minute, that is 7 hours. The parameter oh pH, conductivity (ms/cm), turbidity, dissolved oxygen (mg/L), temperature (°C), salinity (%), intensity and survival rate is increase to normal condition, almost same or near to control water, and the fish is survive.

From the graph, see Figure 6 and Figure 7 below which show of waste water quantity versus survival time for four and seven hours running time, we can see the graph show the increase of survival time of fish. Starting from one minute for the first liter of waste water until last liter of waste water that is about 60 liter. From the graph of four hours, the fish start survives at liter 40, which is on 144 minute and for seven hours, the fish start survives at liter 50 on the minute of 280.

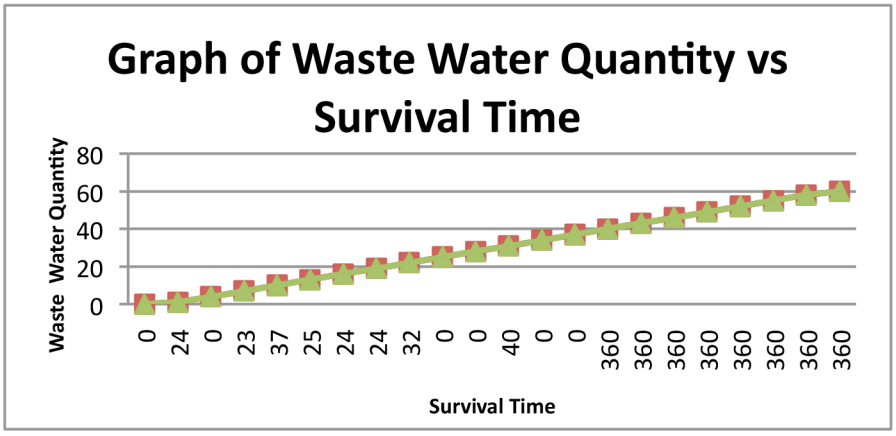

Figure 6: Graph of Survival Time for Four Hours

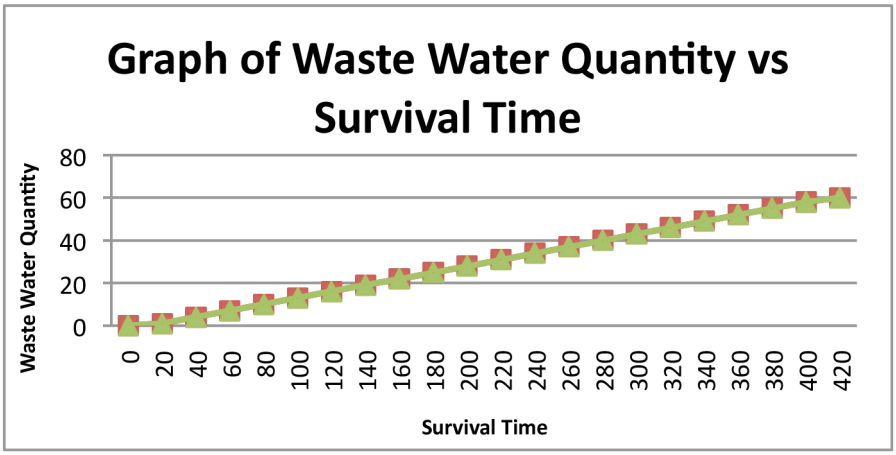

Figure 7: Graph of Survival Time for Seven Hours

RECOMMENDATION AND CONCLUSION

As the conclusion, as we know the circulation of water can make the toxin is move out from the tuber. So, with this technology we can reduce operation time if comparing with the traditional method.

For recommendation, I suggested this machine can improve the design for look more interesting and fully automated. Publish this machine in the internet to introduce this machine to other people that have need commercial the product of *Dioscorea hispida* tuber. This machine is easy to use and a simple machine that makes people can save time to remove the toxin. I also recommended try to test the waste water other than fish, for example rat, this is because the rodent are small and adapt well to new surroundings. Use as source of water for rat for a few days. So, the effect maybe can be seeing more clearly.

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Angela M. Fraser, Ph.D., Associate Professor/Food Safety Specialist Department of

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Nurul Syuhada Mohamad
Mohd. Hudzari Hj Razali
Nashriyah Mat
Faculty of Agriculture
Biotechnology and Food Science
Universiti Sultan Zainal Abidin (UniSZA)
21300, Gong Badak, Kuala Terengganu
Terengganu, Malaysia

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Genetic Algorithm Optimization for 4th-Order Multiple Feedback High Pass Filter

Eng Kok Khoon & Neoh Siew Chin

ABSTRACT

In this paper, a genetic algorithm (GA)-based optimization model is developed to optimize the 4th-order multiple feedback high pass filter. The 4th-order multiple feedback high pass filter is synthesized using LTspice whereas the GA model is developed using MATLAB. Ten design variables of the filter are manipulated to optimize the filter performance in terms of gain, cutoff frequency and pass band ripple. Overall results meet the targeted performance and have been shown to satisfy the required constraints.

Keywords: Genetic Algorithm, Multiple Feedback High Pass Filter, Parameter Optimization

INTRODUCTION

Optimization is the procedure of making something better and effective [1]. Optimization algorithms have been extensively developed and widely applied in engineering systems. It involves investigation on the variations of the initial concept and enhancement of ideas based on the information obtained. Many optimization problems from the world of industrial engineering are very complicated in nature and quite difficult to solve by conventional optimization techniques [1,2].

Genetic Algorithm (GA) is pioneered by John Holland in the early seventies. It mimics the natural process of human evolution and is applicable to a wide range of problems [2, 3, 4]. To solve a problem, a GA maintains a population of individuals so called chromosomes and probabilistically modifies the population in the course of some genetic. These operators include selection, crossover and mutation, with the goal of acquire a near optimal solution to the problem [5].

This project focuses on the optimization of a 4th order multiple feedback high pass filter. A GA technique is used in conjunction with the circuit simulation system of LTspice to simulate and optimize the filter performance. This study investigates GA's applicability towards filter design and its potency to replace the conventional trial and error method in circuit design optimization.

4-TH ORDER MULTIPLE FEEDBACK HIGH PASS FILTER

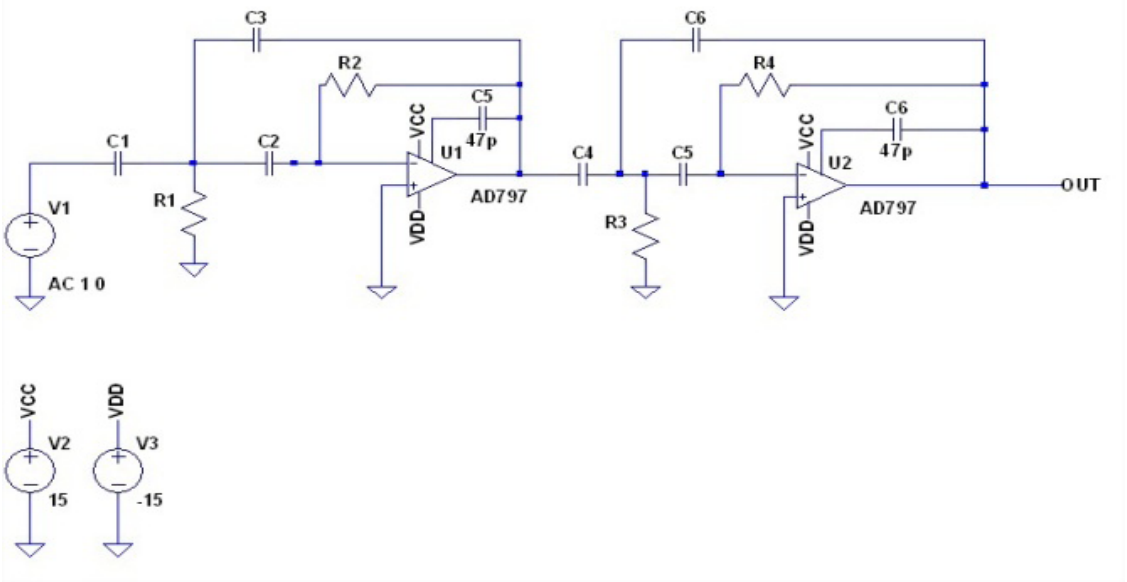

Figure 1: 4th order multiple feedback High-pass filter schematic design

High-pass filter is an electronic filter that passes high-frequency signals but attenuates signals with frequencies lower than the cutoff frequency [6,7]. 4th-order multiple feedback high-pass filter can be built by cascading two building blocks made of second order high pass filter. Generally, higher-order high pass filters are applied to sharpen a desired filter characteristic. The multiple feedback topologies are commonly used in filters that require high gain. In this study, the filter is obtained from LTspice. Figure 1 shows the schematic design of the investigated 4th-order multiple feedback high-pass filter. Note that each high-pass filter stage in Figure 1 needs three capacitors to get a second-order response. Filter parameter cannot be independently adjusted as each component may affect more than one filter characteristic.

It is undeniable that conventional trial and error optimization of filter parameters are tedious and time consuming. By considering the population-based stochastic nature of GA, simultaneous optimization of filter parameters are made possible. According to [8], GA can be used to solve multi-dimensional, non-differential, and even non-parametrical problems. Table 1 lists all relevant design variables in filter optimization. These variables are to be tuned to obtain the required specifications of gain, cut-off frequency and pass-band ripple given in Table 2.

Table 1 synthesis setup of design variables

Component	From	To
C1	1n	10n
C2	1n	10n
C3	500p	1500p
C4	5n	200n
C5	10n	100n
C6	1n	50n
R1	1k	50k
R2	1k	50k
R3	10	400
R4	1k	50k

Table 2 The required specification for filter design

Output	Minimum	Maximum	Optimize	Weight
Gain	6dB	15dB	Maximum	3
Cutoff frequency	8000 hz	12000hz	Target: 10Khz	3
Passband ripple	-	2dB	Minimize	5

GENETIC ALGORITHM

Genetic algorithm (GA), is a powerful heuristic search derived from evolutionary techniques and the principle of nature selection [1, 3]. It is an evolutionary-based approach that is widely used in machine learning engineering design and optimization problems. GA has been hypothetically and empirically verified to be robust. In GA, each possible point or solution in the problem search space is encoded into genetic representation. By using the Darwinian principle of the survival of the fittest, GA transforms a population of individual solutions into a new generation of population through probabilistic selection. The selection mechanism is carried out based upon the individual's fitness in which better individuals stand higher chances to be chosen for reproduction. In reproduction mechanism, GA produces better approximations towards the solutions by employing genetic operations of crossover and mutation. After several generations, the algorithm converges to the best solution which is expected to represent a optimum or suboptimal solution to the problem.

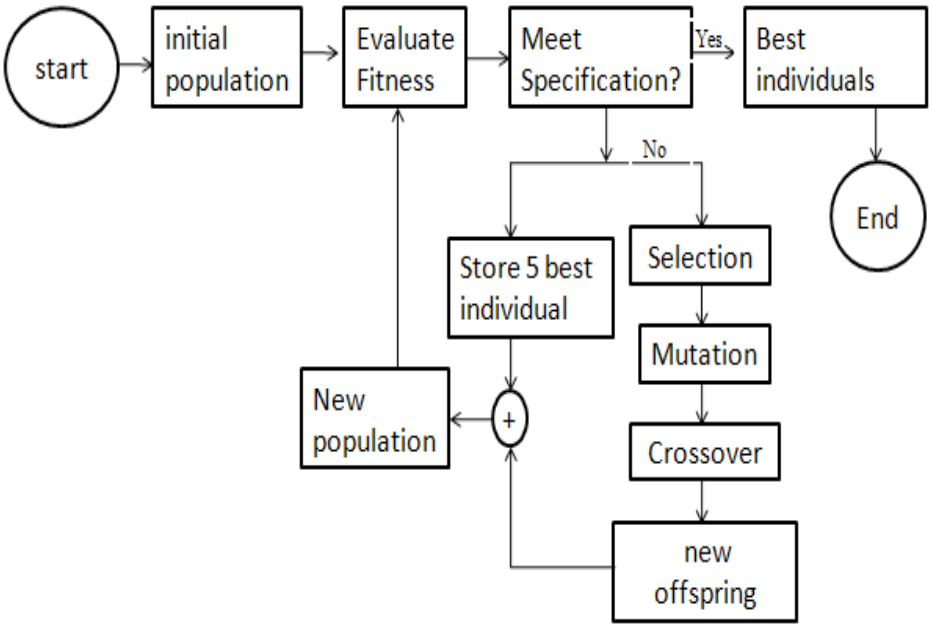

Figure 2: Overall GA flow

GA-LTSPICE OPTIMIZATION

The overall flow of GA employed in this study is illustrated in Figure 2. Based on Figure 2, the algorithm starts with the initialization of population.

Population Initialization

A population of possible candidate solutions or so called chromosomes is randomly generated. These chromosomes comprise of a series of genes which represents the filter parameters. Each gene in the chromosome represents a specific filter parameter. The combination of these genes produces a chromosome representation for candidate solution. Based on the required constraints of the design variables in Table 1, the chromosomes are randomly initialized within the allowable range given.

Fitness Evaluation

All generated chromosomes or candidate solutions are simulated in the LTspice circuit simulation system to obtain the filter performance in terms of gain, cut-off frequency, and pass-band ripple. Based on the required constraints and optimization mode of each specification in Table 2, a fitness function is developed to evaluate the achievement of each specification. In the evaluation, chromosome is given a penalty value, α, when the gain, cut-off frequency and pass-band ripple exceed the permitted constraints. Equations (1-3) show the fitness evaluation for each different specification where F_1, F_2 and F_3 are fitness for gain, cutoff frequency and pass-band ripple respectively. In order to get the overall fitness for the chromosome, a normalized weighted-sum approach is used to sum up all the specification fitness and reduce the possible bias caused by different specification [4]. The total fitness, F_{total}, is calculated relatively based on the average specification fitness in the first GA generation as given in (4).

$$F_1 = \begin{cases} \alpha + (\text{Gain} - 15), & if\ gain > 15 \\ \alpha + (6 - \text{Gain}), & if gain < 6 \\ \alpha - \text{Gain}, & \text{if } 6 \le \text{gain} \le 15 \end{cases} \quad (1)$$

$$F_2 = \begin{cases} \alpha + (cutoff - 12000), if\ cutoff > 12000 \\ \alpha + (8000 - cutoff), if\ cutoff < 8000 \\ cutoff - 10000, if\ 10000 \le cutoff \le 12000 \\ 10000 - cutoff, if\ 8000 \le cutoff < 10000 \end{cases} \quad (2)$$

$$F_3 = \begin{cases} \alpha + (\text{ripple} - 2), & if\ \text{ripple} > 2 \\ \alpha + (0.05 - \text{ripple}), & if\ \text{ripple} < 0.05 \\ \text{ripple} - 0.05, & \text{if } 0.05 \le \text{ripple} \le 2 \end{cases} \quad (3)$$

$$F_{total} = \sum_{i=1}^{3} \lambda_i \frac{F_i}{F_{i\,average}} \quad (4)$$

$F_{i\,average}$ = Average specification fitness of i^{th} specification at the first GA generation
F_i = Fitness value of i^{th} specification
F_{total} = Total fitness
λ_i =Weight for i^{th} specification

Termination Criterion

With the fitness obtained in (4), the best found chromosome's specification is compared to the targeted value of gain, cutoff frequency and pass-band ripple in Table 2. GA is terminated when the required specifications are satisfied. Otherwise, the algorithm will proceed to the mechanism of selection, crossover, and mutation. In this study, 5 best individuals or chromosomes will be stored to the next generation to retain excellent features of the previous generation.

Selection, Crossover, and Mutation

In the selection mechanism, individuals are chosen from the initial population to be parents. Based on the Darwinian's evolution theory, the fittest will have higher chance to be selected for reproduction of new offspring. There are several selection techniques such as roulette wheel selection, steady state selection, tournament selection, elitism selection, and etc [9]. Stochastic universal sampling (SUS), a single phase sampling algorithm which exhibits minimum spread and zero bias is used to perform selection in this study.

The selected chromosomes will undergo the genetic operation of crossover and mutation. This research used single-point crossover with a probability of 0.8 where certain genes of the chromosome are inter-exchanged starting from a randomly selected point in the chromosome. This process combines features of two individuals and create offspring for the next generation. Besides crossover, a single-point mutation with a probability of 0.2 is also employed in this research. In the mutation mechanism, a randomly selected gene of a selected individual is altered to create search diversity.

RESULTS AND DISCUSSIONS

Based on the developed GA, the optimized design variables for the 4^{th}-order multiple feedback high-pass filter are shown in Table 3.

Table 3: Optimized design variables for 4^{th} order multiple feedback high pass filter

Component	GA recommended value
C1	1n
C2	1n
C3	1168p
C4	148n
C5	67n
C6	24n
R1	16k
R2	33k
R3	229
R4	34k

GA is compared to FilterPro (a circuit design system) to investigate the capability of GA in optimizing the 4th-order multiple feedback high-pass filter. The performance in terms of gain, cutoff frequency and pass-band ripple are assessed and shown in Table 4. Based on the recommended value of the design components in Table 3, GA managed to achieve a gain of 14.476 dB, a cut-off frequency of 9.9909 kHz which is very close to the target value 10K Hz and a pass-band ripple of 0.0409 dB. From the results, although GA provides slightly lower gain than Filterpro, it should be noted that the optimization weight given to output gain is only 3 as compared to the weight of 5 for pass-band ripple. The recommended filter design of GA outperforms FilterPro in terms of passband ripple. Besides, the cutoff frequency of GA is very much closer to the targeted value as compared to FilterPro.

Table 4: Results comparison between GA and FilterPro

Optimizer	Gain	Cutoff frequency	Passband ripple
GA	14.476dB	9.9909kHz	0.0409dB
FilterPro	15dB	9.1097kHz	0.500917dB

Overall, it is observed that GA performs better in optimizing the passband ripple and cutoff frequency compared to FilterPro. The optimized result of GA meets the requirement of the 4th order multiple feedback high pass filter.

SUMMARY

This paper described the optimization of a 4th order multiple feedback high pass filter using GA. Results show that GA is a potential alternative approach to be used in assisting filter design, replacing the conventional trial and error approach. Besides, it shows comparable results to the current circuit design system of FilterPro. With the availability of any circuit simulation system, GA can be used to improve the search for design variables optimization.

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Eng Kok Khoon* & Neoh Siew Chin
School of Microelectronic Engineering, Universiti Malaysia Perlis (UniMAP),
Blok A, Kompleks Pusat Pengajian Jejawi I, 02600, Jejawi, Perlis, Malaysia.

**Corresponding email: scneoh@unimap.edu.my*

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Early Detection Techniques for Basal Stem Rot Caused by *Ganoderma Boninense* Disease of Oil Palms: Article Review

Nur Aqilah & Muhammad Mukhlisin

ABSTRACT

Recently, oil palm cultivation has been on high demand both for food industry and as alternate fuel and some in cosmetics products. As the most productive oil seed in the world, many countries take this opportunity to make some profit with this plant as one of the profitable source of economy. Today, Malaysia and Indonesia become the largest exporters of crude oil palm, therefore extensive research must be done to overcome or at least decrease the major factor of destruction of this plant through a fatal disease called Basal Stem Rot. The causing agent is identified as Ganoderma Boninense, one of fungi species that attack at the trunk of palm oil tree. Thus, early detection on this plant's epidemic has to be highlighted using some of previous techniques that can detect any stress on plant. Through this review, we stress the cause of the Basal Stem Rot (BSR) disease and how it spreads to palm oil tree. Several detection techniques are discussed and we highlight on the latest technology using ECVT (electrical capacitance volume tomography) for its practicality, mobility, cost and safety to be used in the field.

Keywords: *tomography, oil palm, basal stem rot (BSR), ganoderma, desease*

INTRODUCTION

Every day the whole world will use palm oil as one of the common cooking oil in their food and also as one of the alternate fuel. As it is the cheapest oil to produce and refine, it is used widely in Africa, Southeast Asia and Brazil since the demand for oleo chemical and energy industries have increased by time. Another useful product that can be commercialized from palm oil is biodiesel. The organic waste such as oil palm shells and its fruit bunches can be used to produce the energy.

Historically, oil palm was introduced in Malaysia as ornamental in 1871 and later commercially exploited as oil crop from1911 when the first oil palm estate was established (Basiron *et al.,* 2000). On the other hand, Indonesia has become the leader in producing and exporting palm oil followed by Malaysia, and Thailand. Besides, palm oil is the cheapest edible oil in the world compare to soybean, rapeseed and corn. It is proven that palm oil industry in Malaysia grows successfully when it is now the largest producer and exporter of palm oil in the world, accounting for 52% or 26.3 million tonnes (MnT) of the total world oils and fats exports in year 2006 (Sumathi *et al*., 2008).

On the other hand, various countries all around the globe are facing with crucial energy issue where almost of them depend on fossil fuel as primary source of energy. In fact, environmental issue such as emission of greenhouse gas (GHG) has caused great concerns regarding to usage of petroleum as a source of energy for vehicles as well as industrialization. Therefore, as an alternative, palm oil offers the best price compare to another vegetable oil to produce biofuel. However, the

growth of oil palm industry especially in many countries faces a critical constraint to sustain the effectiveness of the productivity. A disease called basal stem rot (BSR) has widely attack this oil crop. It affects the economy of oil palms in various countries around the world especially South East Asia (Corley *et al.* 2003).

According to Miller *et al.* (1994), basal stem rot disease causes large amount of losses in terms of revenue and this epidemic has damaged the oil palm plantations in Malaysia for more than 50 years. Same case with Indonesia where the disease has caused dead palms until 80% or more of the oil palm population, and it has decreased the oil palm product per unit area (Susanto, 2009). In this study, some information on production of oil palm in certain countries is reviewed. In the subsequent section, the importance of deep research on how to improve and sustain the palm oil as prominent source of food and biofuel. Finally, detail discussion about the cause of disease that attack palm oil trees, symptoms and some techniques to detect the disease are provided before it can rotten to the trunk.

PALM OIL PRODUCTION

Agriculture industry of palm oil in Malaysia has a wide prospect in expanding the wealth to the country as long as the commercial importance of the fats and oils increase continuously and stable. Malaysia is blessed with favorable weather conditions which prevail throughout the year which is advantageous for palm oil cultivation (Yusuff, 2006). Moreover, the total oil palm planted area in Malaysia increased by 2.8% to 4.17 million hectares in 2006 where Sabah remained the largest oil palm planted state with 1.24 million hectares or 30% of the total planted area (Sulaiman et al. 2011).

In Malaysia alone, the amount of production and export of palm oil has been increasing gradually since 1980 to 2007. Obviously, Malaysia puts on a very high intensive care on palm oil- based agriculture industry as we can see the fluctuation of production is higher as time goes by where the production of palm oil in 1990 to 2000 is 4.7 million tonnes while in 1980 to 1990, the production is lesser that is 3.5 million tonnes (Man *et al.*, 2009).

Table 1 shows that Indonesia and Malaysia dominate the production of palm oil surpass Thailand, Colombia and others. In 2012, Indonesia has produces 28,500 metric tonnes of palm oil, followed by the second largest producer of palm oil, Malaysia with 19,000 metric tonnes of palm. While Malaysia exports a tremendous amount of palm oil in 2012 with 17,200 metric tonnes, Indonesia has overcome the good news by exporting 20,100 metric tonnes of palm oil across the globe.

Table 1: Palm Oil – World Supply and Distribution

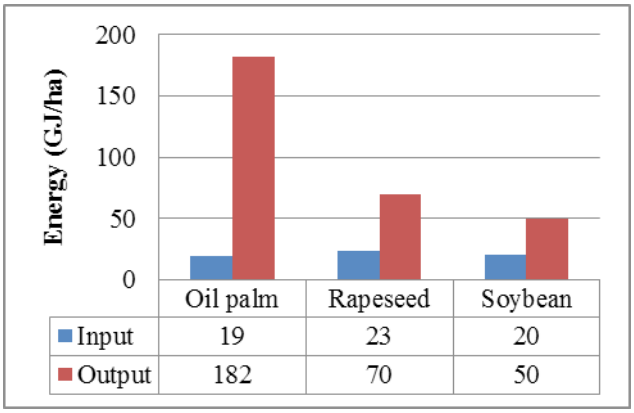
	2010/11	**2011/12**	**2012/13**
Production (mil. tonnes)			
Indonesia	23,600	26,200	28,500
Malaysia	18,211	18,202	19,000
Thailand	1,832	1,892	2,000
Colombia	750	915	960
Nigeria	850	850	910
Other	3,435	3,796	3,921
Total	48,678	51,855	55,291

Source : USDA, 2013

PALM OIL AS BIOFUELS

Two main criteria to be fulfilled by renewable energy are readily available and economically feasible. An alternative fuel must be technically feasible, economically competitive, environmentally acceptable and readily available (Sumathi *et al.*, 2008). As crude petroleum hit record height every other day in term of its price, there is no other way except to find sustainable energy such as wind, solar, geothermal and biomass but unfortunately, they do not satisfy the need of affordable price for consumer (Man *et al.*, 2009).

Biodiesel is defined as the mono-alkyl esters of long-chain fatty acids derived from renewable feedstock, such as vegetable oils. It is synthesized from the triglycerides in vegetable oils by trans etherification reaction with alcohol. In this reaction, the oil reacts with an alcohol in a number of consecutive and reversible steps to form esters and glycerol (Tan *et al.*, 2009). According to Meher *et al.* (2006), the main advantages of using biodiesel are such as lower dependence on crude oil, renewable fuel, favorable energy balance, and reduction in greenhouse gas emission. Moreover, the advantage of using palm oil as alternative fuel is that the energy balance between the energy outputs to input for the production is highest among rapeseed and soybean (Figure 1). It means, the energy input such as the use of fertilizer, pesticides, fuel for machinery and sunlight is the least to other vegetable oil's plant. In fact, palm tree has a long life cycle without annual sowing as it is one of the perennial crops.



Output/Input Ratio (O/I)	Oil palm	Rapeseed	Soybean
GJ/ha	9.6	3.0	2.5

Figure 1: Comparison of energy ratio of output to input for palm oil, rapeseed and soybean
Source: MPOC, 2006

DISEASE IN PALM OIL

Basal Stem Rot is caused by fungus called Ganoderma Boninense (Figure 2). It was reported that Ganoderma Boninense is the common species that related to the BSR while the most frequent disease incidence is in coastal area. Lately, the disease has been detected to attack very young palm oil between 1 or 2 years old palms according to Singh (1991), but it is also has been observed that the disease attack the 4 and 5 years old palms in replanted area. This devastating disease can kill up to 80% of oil palms before they can reach their normal halfway of lifespan.

According to Idris *et al.* (2000), there are 3 different kinds of basidiomata in term of colours (Figure 2). Type A is dark shiny red to dusky red, type B is reddish yellow to yellowish redwhile type C is dark brown to dull which is seen in dead palms or forest trees only.

Figure 2: Different types of basidiomata of Ganoderma
Source: Idris *et al.* (2000)

There are some visible symptoms that can be seen through naked eyes on the infected trees such as appearance of white fungal mass, chlorotic leaves, formation of basiodomata and another internal symptom (Alizadeh *et al*., 2011). In fact, the male flower and fruits stop to grow. Based on research by Paterson (2007), the spear leaves remain unopened the fronds become yellow and consequently lead to necrosis. After destroying the living tissues of the oil palm, the fungus will cause the xylem of the tree malfunction and cannot distribute the water evenly and eventually lead to the death of the oil palm trees. Due to some extent, the frond bases can be removed easily due to the infection and eventually some of the oil palm trees will collapse (Sanderson, 2005). Researches have been done to identify how this disease infects the oil palm trees and researchers have some arguments whether it is because of the spread of fungal spores or by root contact with infected soil. According to Paterson *et al.* (2000), the fungus is spread by spores and grows in the non-living tissues, which weakens the tree making it susceptible to wind damage. On the other hand, infection of Ganoderma to young oil palm can be happened through root contact when the seedling palm is planted too close to infected palm trunk or stump (Sanderson, 2005).

EARLY DETECTION TECHNIQUES

Molecular Techniques

Nowadays, there are several methods or techniques that can be applied to protect the presence of disease in plant in earlier stage. For conventional method, a lot of molecular techniques are used such as enzyme-linked immunosorbent assay (ELISA), Multiplex polymerase chain reaction (MPCR), deoxyribose nucleic acid (DNA) as well as ganoderma selective medium (GSM) (Sankaran *et al*. 2010).

ELIS

Presently, the disease in plant is likely to be detected using molecular technique based on fact that its sensitivity to detect the minimum amount of microorganism ranged from 10 to 10^6 colony forming unit/mL. In the ELISA-based disease detection, the microbial protein (antigen)

associated with a plant disease is injected into an animal that produces antibodies against the antigen and then the antibodies from the animal are extracted to detect the presence of the disease. Unfortunately, this method is labor intensive, time-consuming and requires a lot of procedure in collecting and extracting the sample.

Multiplex PCR-DNA analysis

For PCR-based disease detection, the DNA from the microorganism that causes the disease is extracted, purified and amplified. After that, gel electrophoresis is tested and whenever a specific band presents, the disease-causing microorganism existence is proven.

The function of Ganoderma Selective Medium (GSM) is to determine the growth of bacteria or fungi. Potato Dextrose Agar (PDA) was used for culture maintenance. This test can differentiate types of Ganoderma species with respect to the different result of band (Figure 3).

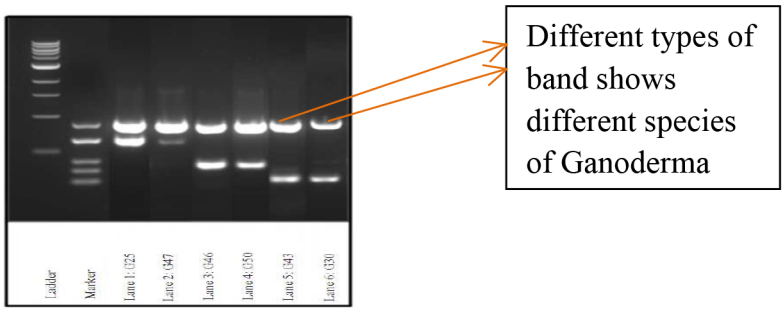


Figure 3: Results of Multiplex Polymerase Chain Reaction (MPCR) for different types of Ganoderma. Source: Ling *et al.* (2012)

Imaging Techniques

In spite of molecular techniques, spectroscopy and imaging techniques are used widely in detecting the stress level and lack of nutrient in the plants. Some of them are fluorescence spectroscopy and fluorescence imaging. What makes these two techniques different is the imaging techniques are developed to enlarge the area of spectral information as well as serve three-dimensional spectral information in the forms of image which improvise the spectroscopy techniques.

Fluorescence imaging

Several imaging techniques have been used in agricultural industry especially to identify any defect or disease in the plant. One of them is using fluorescence imaging technique. This method is applicable to differentiate the ripeness of palm oil, thus only ripe palm oil will be processed to optimize the oil extraction rate. If the palm oil is under or over ripe, it is highly possible that the quality and amount of the palm oil is much lower.

The ripeness of palm oil fresh fruit bunches (FFB) can be categorized as in Table 4. By using this technique, FFB palm oil were scanned by Multiplex® 3 which consist of four light sources namely ultraviolet, blue, red and green. Different emission value in the result showed different categories of the ripeness. Any changes in blue-green fluorescence and chlorophyll florescence of the plants would determine the condition of the plant in term of physiological aspect.

Table 4: Classification of oil palm fresh fruit bunches regarding ripeness condition

Category	Description
Ripe	10–50% of fruits detached from bunch
Over-ripe	50–90% of fruits detached from bunch
Under-ripe	1–9 fruits detached from bunch

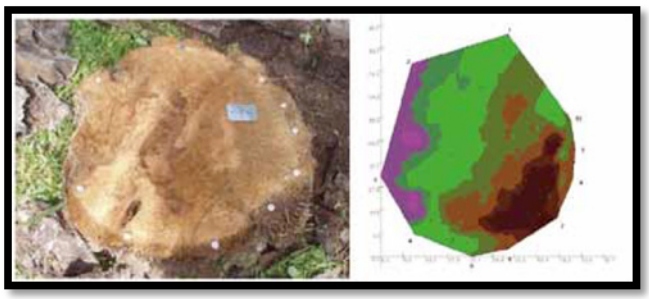
Source: M. Hazir *et al.* (2012)

Electronic nose (e-nose)

Recent development introduced an electronic device called electronic nose which can be used to sense the odor, recognize and classify the volatile compounds in a tree by mimicking human olfaction functions (Markom *et al*. 2009). A series of gas sensors in the device can differentiate the organic compounds present in the air with high sensitivity. Therefore, if any changes in the normal odors of the tree happened, it can be detected by this device including inspecting the cause of the disease such as fungi and bacteria.

GanoSken

Another method to detect presence of Ganoderma in palm tree is using sound image tomography. This device called GanoSken. According to Idris *et al.* (2010), GanoSken refers to the cross-sectional imaging of an object from either transmission or reflection data collected by exposing the object under study to a source wave coming from many directions (Figure 4). Different image colors show different wave velocity, the higher the velocity, the healthier the tree.



4(a) 4(b)

Figure 4: Cross-section of palm tree trunk 4(a) and 4(b) tomography image of diseased palm tree related to Ganoderma where green colour is the infected area while brown colour is healthy stem tissues. Source: Idris *et al.* (2010)

Gamma Ray, X-Ray and ECVT

Present status of invention relates to apparatus using gamma radiation (Gamma CT) to detect and measure the physical condition of the trunk without the needs to cut down the oil palms. The results are presented in the form of cross-sectional image of density profile of ionizing radiation when traversing through the oil palm trunk. In contrary, the mobility and handling aspect of this technique can be questioned due to its various components such as radioactive source holder, a radiation detector holder, a pair of linear translation arms and a circular motion rig (C-frame). In addition, the time that is required in imaging the oil palm trunk cannot be completed before five to six hours operating.

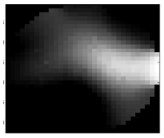
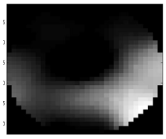
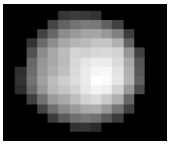
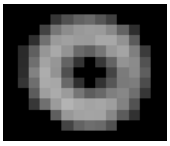
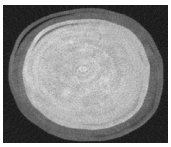
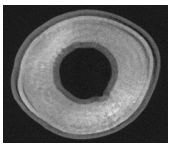
Modality	Original Condition	Hole at Centre Condition	Scanning Time
ECVT			10 sec
Gamma CT			5 hours
X-ray CT			45 min

Figure 5: Time taken to image oil palm tree using ECVT, Gamma CT and X-ray CT

Besides, X-Ray gives a very clear and sharp image in just 45 minutes after operating. Due to safety aspect, this kind of techniques is not favorable to be used in the field as well as its huge machine and operating system. Figure 5 shows the time taken to screen the image between three imaging techniques, namely Electrode Capacitance Volume Tomography (ECVT), Gamma CT and X-ray CT.

In the presence paper, as one of the latest imaging technique that can serve the real time-3D volume imaging, ECVT or electrical capacitance volume tomography has been introduced. 3-D image is reconstructed by a 3-D capacitance sensor through capacitance signal. Tomography provides several real- time methods for obtaining cross-section images of a process to gain information on the material distribution (Mohamad *et al.* 2012).

ECVT utilizes then nonlinearity in electric field distribution to track changes in phase distributions (Fei *et al.* 2010). Not only it can be applied on complex geometries, it is also low in cost, easy to handle, safe and faster than the other imaging technologies such as Gamma-ray and X-ray. However, there is limitation in this technique that is nonlinearity in resolution thus provide inadequate spatial resolution.

DISCUSSIONS

Many benefits and advantages offer by palm oil cultivation lead the developers, stakeholders and also researchers to involve in this industry without hesitate. This energy crop provides direct and indirect employment to 860,000 people excluding other multi-plying effects and spin-offs activities (Sumathi *et al.,* 2008). Approximately 80% of the production of palm oil is used in food industry as cooking oil and additive in food. In Sabah and Sarawak, the drastic increase in the 1990s can be attributed to the government policy in the intensification of palm oil industries in East Malaysia (Abdullah *et al*., 2009).

Ganoderma attacks palm trees early as 10 to 15 years old trees since 1957 and recently it was claimed that the spread of the disease occurs in younger palm trees. This shows that the fungi has adapted to its surrounding and act as parasite specifically to the root of the tree. Several species had been reported to be responsible for BSR disease of oil palm in Malaysia namely, G.

boninense, Ganoderma zonatum and Ganoderma miniatotinctum respectively, while Ganoderma tornatumis non-pathogenic, infecting only dead trunks of oil palms (Ling *et al*., 2012). However, in this review focus on Ganoderma boninense as it is the most aggressive pathogen.

Furthermore, species of Ganoderma are the causal agents of rots of numerous other plantation crops including coconut, rubber, betel nut, tea, cocoa, guarana and grapevines. Forest trees such as Acacia, Populus and Macadamia are also affected (As`wad *et al*., 2011).

Many of molecular techniques to detect the disease in plant have been used and one of them is Ganoderma Selective Medium (GSM). By using Potato Dextrose Agar (PDA), the fungi of Ganoderma is let to be growth in the medium before doing DNA extraction to distinguish different types of fungi since there are non-pathogenic species. Therefore, the ability to differentiate pathogenic and non-pathogenic Ganoderma species can assist in decision making of whether to treat the palms; if the infection is determined to be caused by non-pathogenic Ganoderma species, then, it is unnecessary to take drastic control measures as it only infects dead palms, thus saving enormous budget and man power used for control and preventive measures (Ling *et al*., 2012).

Even though ELISA is a popular technique to detect the abnormality and stress in plant due to its high sensitivity to identify the microorganism, it requires many steps to obtain the result, especially in labor work, and also time consuming in sampling.

According to Sankaran *et al.* (2010), it is estimated that the crop losses due to plant pathogens in United Stated result in about 33 billion dollars every year. By this evidence, an advance technique using non-intrusive method is likely to be used widely in agriculture industry and it is called imaging technique. In fluorescence imaging, a leaf disease can be identified for example, tobacco mosaic virus (TMV) in tobacco plants.

In recent years, a new technology that miming the smell sense in human being is developed through electronic nose system (E-nose). It was reported that the electronic nose system was able to provide a distinct olfactory signature required to identify the disease as early as 6 days after the infection (Sankaran *et al.,* 2010). A real-time series of different sensor can distinguish different smell or volatile organic compound (VOC) because the infected plants will have a different VOC from the healthy plant.

Though X-ray CT and Gamma CT result can satisfy the need to obtain a clearer and sharper image of oil palm trunk, unfortunately this method is dangerous to our body as it can trigger the cancer cell. The size of the machine is the biggest constraint to be used in any oil palm plantation.

The low profile and flexibility of capacitance sensors, increased number of imaging frames per second, and relatively low cost of the ECVT system are characteristics that have moved the technology to the top of the list of industrial imaging tools (Fei *et al*., 2010). The principle of ECVT is the reconstruction of 3D image based on signal from capacitance sensor whereas any changes in phase distribution will result in nonlinearity in electric field distribution.

In addition, the most common cylindrical shape ECVT sensors for such vessels are very common due to their regular shape and potential applications in straight vessels. This kind of shape is suitable in examining the BSR disease in the trunk of palm oil as the major advantage of ECVT sensors is that they can be applied to vessels of various sizes according to the sizes of the objects. In the cylindrical ECVT, there are three-layer sensor contains of four rectangular electrodes in each layer which are shifted 45^{o} with adjacent layer to improve the resolution of the image. When ECVT is operating, the image appear on the screen really depends on the

permittivity of the object. The permittivity is an ability of an object to affect electric field set up in it where the higher the value of permittivity, the lower the electric field that is presented.

CONCLUSION

Basal stem rot disease causes major losses to palm oil industry. This edible oil become one of the economy importance for Malaysia as it is readily available throughout the year and the most traded vegetable oil in the world. Intensive care is highlighted on the causes of BSR in palm oil plant in order to minimize the destruction of many other trees in the future. Some of techniques are identified to be the detector of the disease in plant and the latest technology that can detect the defect in tree is ECVT, electrical capacitance volume tomography. We want to emphasize on non-destructive method in detecting the disease, thus the plant remain undisturbed during the test.

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Nur Aqilah
Department of Civil and Structural Engineering
Universiti Kebangsaan Malaysia, Malaysia

Muhammad Mukhlisin
Department of Civil and Structural Engineering
Universiti Kebangsaan Malaysia, Malaysia
Department of Civil Engineering
Polytechnic Negeri Semarang, Indonesia

44

Correlation Between Efflorescence Intensity and Hydration of Pozzolanic Modified Cement System

Norsuzailina Mohamed Sutan, Ibrahim Yakub,
Mahmuddin Selbi & Sinin Hamdan

ABSTRACT

This study focuses on the effectiveness of Silica Fume (SF) as pozzolanic cement replacementsin reducing efflorescence on the surface of Ordinary Portland Cement (OPC) paste. Previous studies have found that SF can potentially enhance the performance of cement mainly due to their reaction with calcium hydroxide (C-H) to develop more of the strength-carrying compound in cement structure namely calcium silica hydrate (C-S-H). This pozzolanic reaction is crucial in the mitigation of efflorescence by its relation to C-H leaching. The early hydration behavior of Pozzolanic Modified Cement Paste (PMCP) that hypothetically affects efflorescence has been investigated through physicochemical characterization namely Puddle Test (PT), Standard Chemical Method (SCM), Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM). PMCP samples were prepared with water-to-cement ratio (w/c) of 0.5. SF was used as 10%, 20% and 30% cement replacement by weight. Samples were cured at room temperature (32° C) and 90% relative humidity. Powdered and polished samples were prepared and tested at 28 days of hydration. Compared with conventional cement paste, PMCP exhibited lesser efflorescence whereby validation from FTIR spectrum and SEM images showed the evidence of pozzolanic reaction.

Keywords— Efflorescence, Silica Fume, FTIR, SEM

ABSTRAK

Kajian ini memberi tumpuan kepada keberkesanan Silica Fume (SF) sebagai sebagai pengganti simen bagi mengurangkan efflorescence di permukaan simen Portland biasa (OPC). Kajian sebelum ini menunjukkan SF berpotensi meningkatkan prestasi simen disebabkan tindakbalas pozzolan dengan Kalsium Hidroksida (C-H) untuk menghasilkan lebih banyak kompaun yang membawa kekuatan struktur simen iaitu kalsium silika hidrat (C-S-H). Reaksi pozzolan ini adalah ciri yang penting untuk mengurangkan effloresen melalui hubungkait dengan C-H larut lesap. Tingkah-laku kaitan penghidratan awal daripada pozzolanic simen tampal (PMCP) dengan effloresen telah dikaji melalui ujian fikal kimia iaitu Ujian air takung (PT), Kaedah Kimia Standard (SCM), pengimbasan microscopy elektron (SEM). PMCP sampel telah disediakan dengan nisbah air-simen (w/c) 0.5. SF telah digunakan sebagai 10%, 20% dan 30% penggantian simen mengikut berat. Sampel telah dibiarkan menghidrat pada suhu bilik (32° C) dan kelembapan bandingan 90%. Sampel halus dan digilap telah disediakan dan diuji pada 28 hari penghidratan. Berbanding dengan simen yang konvensional, PMCP mempamerkan effloresen yang kurang di mana pengesahan daripada FTIR spectrum, imej SEM dan kekuatan mampatan menunjukkan reaksi pozzolanik telah berlaku.

Kata kunci — Efflorescence, silika Fume, FTIR, SEM

INTRODUCTION

Modern concrete can be made into a variety of finishes and colors offering architects and the construction industry a material that is both practical and aesthetically pleasing. Unfortunately, colors changes of concrete can arise due to a wellknown yet not well understood phenomenon called efflorescence. White efflorescence salts, whilst not increased by concrete pigmentation, are more visually apparent when concrete is colored than when used in its natural grey form. In addition, colored concrete tends to be finished to a higher standard using specification for aesthetic purposes and therefore efflorescence is particularly noticeable in these circumstances [1,2]. Efflorescence ,used to be ignored due to its negligible structural effect, is now viewed as a major problem in colored concrete products. Efflorescence as shown schematically in Fig. 1, is a deposit of crystallized calcium carbonate ($CaCO_3$) on the exposed concrete and cementitious materials manifesting from hazy white layers to thick white crusts [1,2].This manifestation as shown in Figure 2,is caused primarily by the leaching of Calcium Hydroxide (C-H), one of Portland cement hydration products which is slightly soluble in water. It migrates to the concrete surface through the capillary system of the concrete and evaporates to leave the solid C-H which then reacts with atmospheric carbon dioxide (CO_2) to form $CaCO_3$[1,2,3,4,5].

Despite the fact that aesthetic problem is more obvious on coloured surfaces than on the grey ones, and causes economical implication due to products rejection by customers, efflorescence is indirectly related to durability problem in a way that leaching occurred within the concrete can cause an increase in porosity, increase in permeability and decrease in strength, thereby increases its vulnerability to aggressive chemicals ingress [4,5].

To date there are no economical and effective methods to guarantee the prevention of efflorescence. The influence of cement chemistry and its microstructure changes on efflorescence have yet to be further studied in continuation of the basic knowledge of efflorescence. To date there is no effective method that can guarantee the prevention of efflorescence Therefore the focus of this study is to investigate the underlying mechanism that may lead to creating solution that can mitigate its occurrence. To date there is no effective method that can guarantee the prevention of efflorescence [4, 5, 6 ,7,8,9]. Since C-H leaching is the main cause of efflorescence therefore hypothetically, efflorescence can be minimized by minimizing C-H leaching by pozzolanic reaction. One of the highly reactive pozzolanic materials is Silica Fume (SF)[10,11,12]. There are limited data available in the study of the microstructural interaction of Silica Fume in cement based products that can possibly reduce efflorescence. Therefore, it is the motivation of this preliminary study to characterize the hydration products: calcium hydroxide (C-H) and calcium silica hydrate (C-S-H) of Silica Fume (SF) modified cement paste (PMCP) as the fundamental study on efflorescence mitigation.

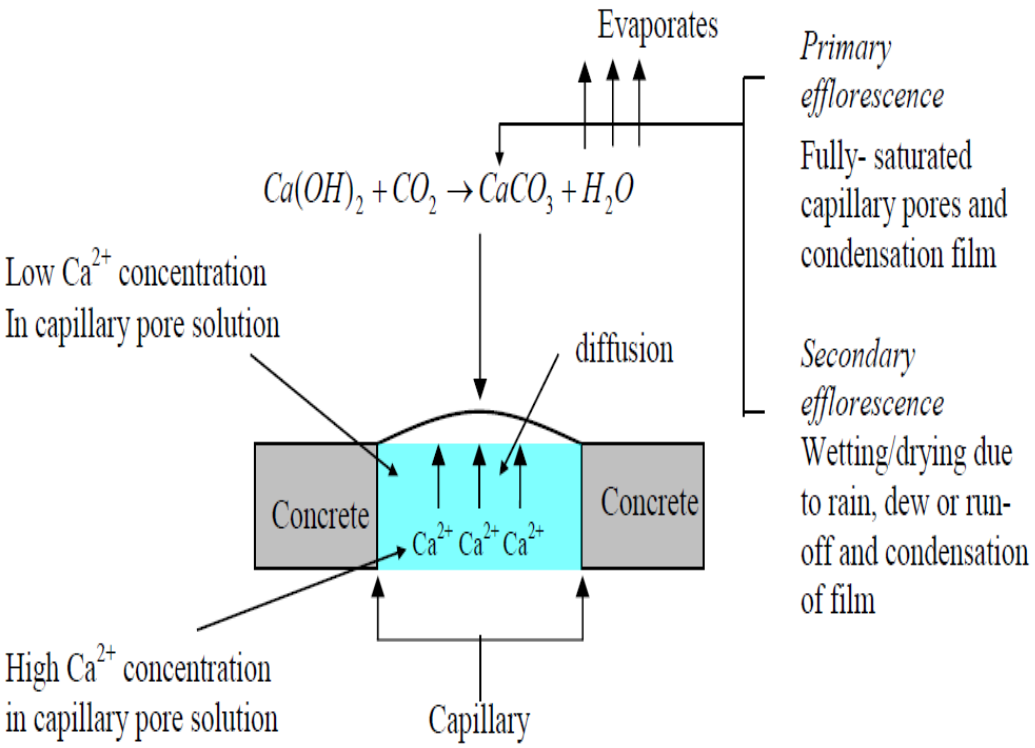

Figure 1: Schematic diagram of Efflorescence from cross sectional view of concrete block

Figure2: Efflorescence on concrete wall

MATERIALS AND METHODS

Materials and sample preparation

Pozzolanic cement replacement chosen for this research was Silica Fume (SF) according to ASTM C 1240 .Cement used was Ordinary Portland Cement(OPC) (ASTM Type 1 recognized by ASTM C150) manufactured by Cahaya Mata Sarawak Cement Sdn. Bhd (CMS) and it exceeded the quality requirements specified in the Malaysian Standard MS 522: Part 1: 1989 Specifications for OPC. The chemical and mineralogical characteristics of the OPC binder are given in Fig. 3. Table 1 shows the chemical and physical properties of Silica Fume.

To study the effect of PMCP on efflorescence, comparative physicochemical analyses were performed using Puddle Test (PT), Standard Chemical Method (SCM), Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscope (SEM). The mix proportion was set at 1:0.4:1.67 for all samples that were casted into Universal Container 30ml, 28 X 85mm for PT, SCM , FTIR and SEM. All samples were dry-cured in the concrete laboratory with average temperature (T) of 32° C and average relative humidity (RH) of 90%. PMCP samples were prepared with water to cement ratio of 0.5and 10%, 20% and 30% of SF cement replacement by weight.

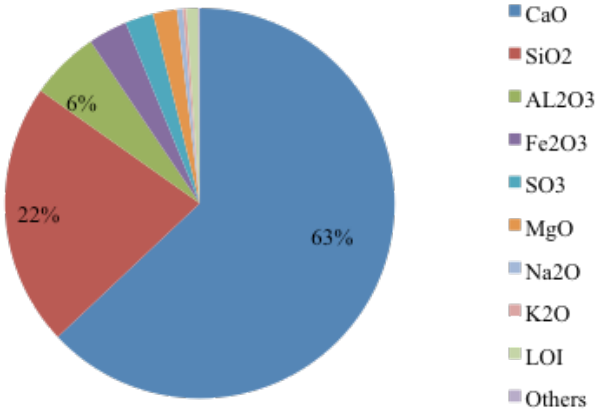

Figure 3: Chemical Composition of OPC

Table 1: Chemical Composition of Silica Fume

Composition (%)	CaO	SiO_2	Al_2O_3	Fe_2O_3
Silica Fume	< 1	93.45	0.58	0.27

Test methods

Efflorescence tests

PT and SCM were performed at day 7, 14, 21 and 28.Puddle test is an accelerated efflorescence test where distilled water of 10 ml was added on samples surfaces in the form of circular drops [6,7].The water in the circle could be vaporized or absorbed by the samples. On specified day, the surface of the samples was scraped to extract powder of 1gram in weight. SCM was used to quantify the amount of $CaCO_3$ from the extracted powder by dissolving it in a diluted hydrochloric acid solution. The dissolved salts was then placed on a filter paper and weighed before it was

oven dried for 24 hours at temperature between 90°C-100°C. Then the sample was taken out and weighed again. The weight loss indicated the amount of the dissolved efflorescence formed on the mortar samples surface.

Characterization by FTIR and SEM

Fine powder samples (passing 75 μm) and polished small samples were prepared and analysed using FTIR and SEM at day 28 respectively. Acetone was used to stop the hydration process of these samples and the test was performed with a Shimadzu Fourier Transform Infrared Spectroscopy (FTIR) 81001 Spectrophotometer. The spectrum measurement method applied in this FTIR study is Attenuated Total Reflection (ATR) method. Transmission infrared spectrum of each sample was recorded using a Fourier Transform Infrared Spectrophotometer (IRAffinity-1) in the region of 400 to 4000 cm^{-1} with 2.0 cm^{-1} resolution. The samples were scanned 20 times. SEM images for all prepared samples were captured by Scanning Electron Microscope (JSM-6701F) supplied by JEOL Company Limited, Japan that followed the ASTM C 1723-10 (2010) code of practice

Results and discussions

Efflorescence intensity

Figure 4 shows efflorescence intensity in terms of percentage of $CaCO_3$ collected from the surfaces of SF modified cement paste samples in comparison with unmodified mortars (Control) of 0.5 w/c ratio for 7, 14, 21 and 28 days.

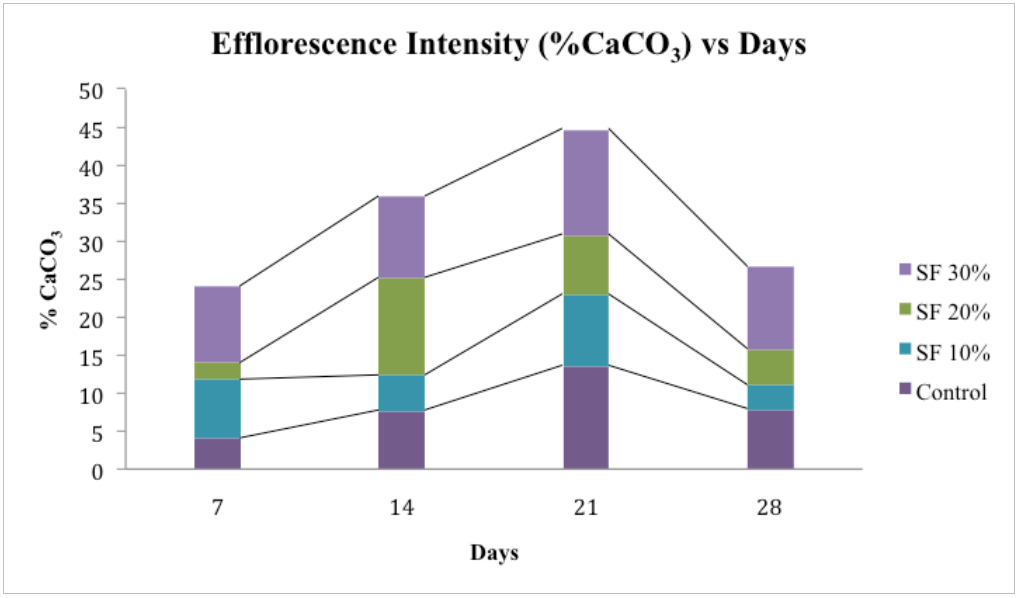

Figure 4. Percentage (%) of CaCO3 versus days for SF modified cement paste and Control

Based on Figure.4, the low efflorescence intensity in terms of percentage of $CaCO_3$ in comparison to control can be found from 10% SF whereas the high efflorescence intensity was manifested on samples with 30% SF replacement. These are the expected results since previous studies have confirmed that cement paste contains SF as cement replacements can produce denser and relatively watertight microstructure which not preferable in mitigating efflorescence due to water puddle or film on the surface that can induce efflorescence [9,10].This is due to the consumption and

the reduction in the amount of calcium hydroxide (C-H) by pozzolanic reaction of SF particles to form additional calcium silicate hydrate (C-S-H) gel that contributes to the densification of interfacial transition zone and lesser porosity of the matrix [10, 11, 12].
Figure .5, 6 and 7 shows FTIR spectra and SEM images. confirmed the findings by the evidence of pozzolanic activity by the abundance presence of C-S-H in 30% SF that creates a dense and relatively impermeable microstructure that promotes efflorescence.

Characterization of C-H and C-S-H using Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM)

The analysis of FT-IR was focusing on C-H and C-S-H band because C-H and CSH are the main characters in pozzolanic reaction. Characteristic of C-H band is at wave number v = 3640cm-1 and C-S-H band at wave number v = 970cm-1 [9]. The comparison of C-H band between 100% OPC (control sample) with SF 10%, 20% and 30% replacement at age 28 days is shown in Figure 5.

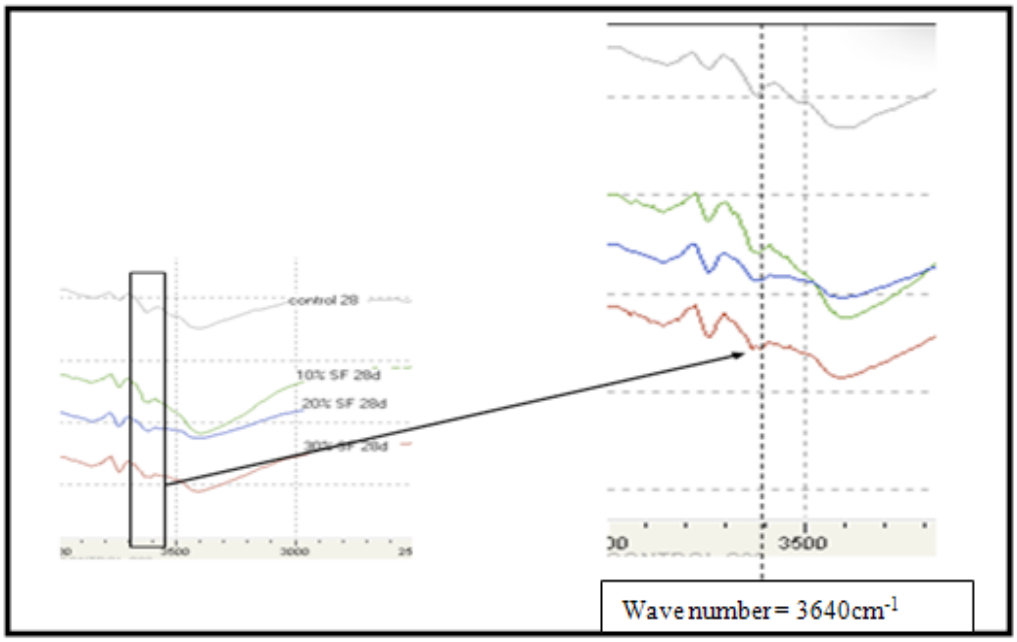

Figure 5: The comparison of C-H band between 100% OPC with SF 10%, 20% and 30% replacement at age 28 days

The result on FT-IR shows that the C-H intensity of control sample is higher than all the modified cement paste. All the bands of the C-H for modified cement pastes are wider than the band of the C-H for 100% OPC cement paste. The lower C-H intensity suggests that pozzolanic reaction occurred in the modified cement. This event was supported by the FTIR result on the C-S-H band at wave number v = 970-760cm-1.

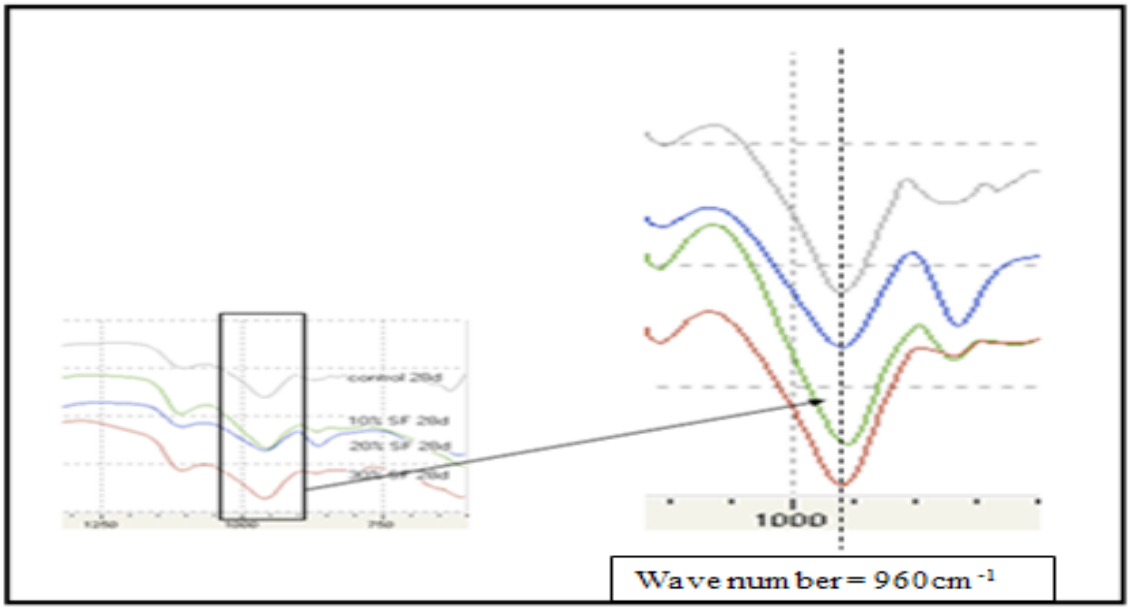

Figure 6 shows the comparison of C-S-H intensity at wave number v = 960cm-1 between all samples.

The 30% of SF replacement sample has the highest intensity of C-S-H and widest C-H band compared with other samples.This shows that the higher amount of SF replacement, the lesser intensity in C-H band will be and the more intense in C-S-H band. It can be concluded from these results that the pozzolanic reaction has occurred in all modified cement paste. This finding is reflected in the morphology of PMCP in Figure 7 showing more C-S-H in 30% replacement in comparison to Control.

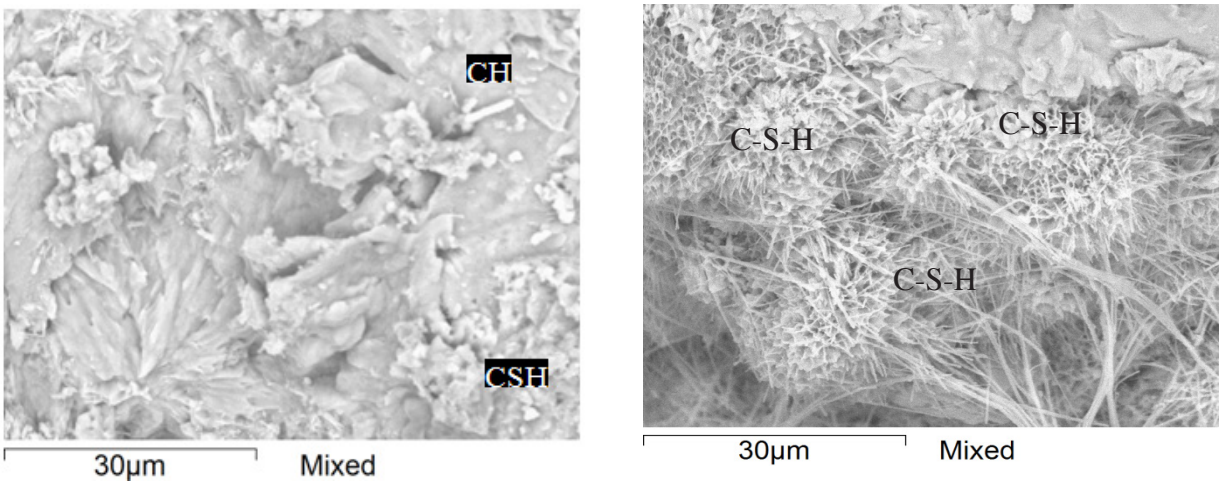

Figure 7: SEM images of (a) OPC (b) 30% SF at day 28

CONCLUSION

From the PT and SCM investigations performed, it can be concluded that PMCP has influenced the efflorescence formation on mortar surfaces to a significant extent through pozzolanic reaction in PMCP. Low efflorescence intensity in terms ofpercentage of $CaCO_3$in comparison to control can be found from 10% SF whereas the high efflorescence intensity was manifested on samples with 30% SF replacement. These findings were reflected in the FTIR spectrum and SEM images. The intensity of the C-H band and C-S-H band are the main concerned bands in this study at the age 28 days of samples. It has been found that 100% OPC cement paste has more intensity in C-H band than modified cement paste. The wider band at wave number v = 3640cm-1 for 10%, 20% and 30% SF replacement cement pastes shows that C-H have reacted with SF and formed C-S-H. This hypothesis has also been supported by analyzing wave number v = 960cm-1 which is the C-S-H band. The most intense C-S-H band is 30% SF replacement cement paste and followed by 20%, 10% and lastly 100% OPC. Further investigation on the extent of reactivity by using other characterization technique is therefore needed.

ACKNOWLEDGMENT

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Norsuzailina Mohamed Sutan, Ibrahim Yakub, Mahmuddin Selbi and Sinin Hamdan
Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak
msnorsuzailina@feng.unimas.my

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The Impact of Trust and Past Experience on Intention to Purchase in e-commerce

Abdalslam. S. Imhmed. Mohmed, Mohd Zalisham Jali
& Nurdiana Azizan

ABSTRACT

Buyer's behavior is affected by different factors that influence the intention to purchase online. This paper specified three factors Trust, Past Experience, and Social Presence that have strong relationship with the intention to purchase online. The study found that all these factors have positive correlation with buyers' intentions and purchasing behaviors, but "Trust" was the strongest factor that affects the intention to purchase online.Therefore the study concludes that trust is the main driver that improves online business. A meta-study of the empirical literature on trust and other two factors in e-commerce systems was conducted, and propose a qualitative model incorporating the various factors that have been empirically found to influence consumer trust increase the intention to purchase online.

INTRODUCTION

Trust and Past experience of consumers were found influential factors that affect the decision of buyers online. Trust is at once an important concept for different fields in business and life, and a critical attribute that must be adopted into e-commerce application. Trust bears a vast number of meanings, and it is deeply dependent upon the framework of information and user's background and perception. The literatures on adopting trust into e-commerce application reflect various meanings of trust with respect to purchasing online; there are a large number of articles discussed trust in e-commerce, but yet there is no clear theoretical support for the investigation of other dimensions of trust in e-commerce, however, is highly dependent on trust unlike traditional commerce; actually most of literatures showed that any e-commerce merchants that fails to establish a relationship based on trust with their customers is destined. Therefore is a firm need for specific guidance on e-commerce websites to adopt the effective dimensions of trust attribute and operate business that effectively promote trust for online buyers. Online trust varies by a consumer's buying experience (Liu, Dixon, and Murphy 2002) and is moderated by the consumer's degree of trust propensity (Lee and Turban 2001) and duration of relationship (Gounaris and Venetis 2002). Extending these notions, this study evaluation the factors that impact on buyer's trust and online purchase past experience as well as examine the effect of social presence on the intention to purchase.

Trust and Past Experience to buy online are the main motives for buyers to proceed in payment with full of confidence, and hence this paper will attempt to approve the correlation between Trust and Past Experience to purchase online with the intention to purchase online, and

to examine the impact of Social Presence as well on buyer's behavior. The intention of buyer to purchase online has been discussed by many studies that highlighted the role of trust and other factors such as experience and social network (Hellier et al., 2003). This study showed that one of the important factors that have a significant influence in intention to purchase online is a buyer's general tendency to trust the e-commerce portal, and this tendency is referred to as "trust affection", which is a psychological attribute that is formed from early childhood and develops throughout the life period depending on an individual's socio-cultural background, developmental experiences, and his or her personality traits (Mayer et al., 1995).

Trust affection is defined in this study as "the degree to which an online buyer displays a tendency to be willing to proceed in purchasing with full confidence". In an e-commerce situation, the findings regarding the impact of trust on online trust are conflicting. The study assumes that "Past Experience to purchase online" & "Social Presence" are reinforcing factors with "Trust" that enhance the intention to purchase online. Social Presence representing the social context by the notions of social presence and trust.

Trust

Academic scholars have accepted trust as a central factor the enables e-commerce business to run successfully (Komiak&Benbasat, 2006; Gefen and Straub, 2010). Rousseau et al. (1998, p. 395) defined trust as: "a psychological position encompasses the intention to accept sensitivity based upon positive expectations of the intentions of the buyer or buyer's behavior. Trust can reduce uncertainty and therefore it is essential for commerce (Blau, 2008), and has been investigated to understand its impact on consumers' fears of unreliability and cheating (Jones & Leonard, 2008). In e-commerce, where the website is the only source of information that should be clear from any kind of uncertainty, however trust in online selling portals is highly important and essential because it is one of the most effective approaches for reducing buyers' uncertainty (Frederick &Schefter, 2000; Luhmann, 1979). Thus, online consumers must trust the seller and be sure that the website is clear from any kind of misuse or contain illegal actions such as violations of security and privacy or unfair prices, trust is likely to play a major role in determining consumers' intentions to purchase.. Collectively, they provide the basis for trust-related decision making regarding a vendor and many of the other trust dimensions proposed in the literature can be reconciled within these two encompassing trust dimensions (Bhattacherjee, 2002; Fuller et al., 2007). Although distinguishing between affective and cognitive trust is often done in explaining the concept of trust, findings from neuroscience indicate that a clear difference between them can hardly be maintained (Riegelsberger et al., 2005). Thus, cognitive trust and affective trust can exist at the same time for the same person(s) towards the same object (Corritore et al., 2003). In this paper, we consider both cognitive and affective trust dimensions.

Social Presence

Social presence defines how people relate to each other, which in turn affects their capability to communicate effectively in different ways (Kehrwald&Bejamin, 2008).

According to the theory of social presence communication would be effective if the communication medium has a proper social presence that is required for the level of personal involvement and for a particular task. For example, the face-to-face medium is considered to have

maximum and highest degree of social presence, whereas text-based communication represents the weakest and lowest level of social presence. This study assumed that the social presence in e-commerce is a moderate level. Social presence theory describe any interaction involving two parties, both parties are concerned both with acting out certain roles and with developing or maintaining some sort of personal relationship (Short & Christie, 1976). The study assumes that social presence has a moderate effect on consumer decisions and their intention to purchase online a supporting factor with trust and experience to purchase online.

Past Experience to purchase online

The previous experience to shop online is an essential factor in deciding the reliability of the website. In this paper we assume that past experience of purchasing online should be considered as an auxiliary factor in the prediction of intentions to purchase online after the Trust factor and in combination with features of the social presence, we will have three factors (Trust, Past Experience, and Social presence) that affect together the decision making process and intention to purchase online. Empirical research (Yoh et al., 2003) shows that customers' previous internet experience is a strong determinant of their online shopping behavior. Moreover, Ranganathan and Jha (2007) found that past online purchasing experience has a strong correlation with intention to purchase online compared to other factors employed in their model

Intention to purchase online is related to the history of internet shopping and has a direct effect on the behavior of internet shoppers (Monsuwe et al., 2004). Knowing how past experience of buyers could affects purchasing behavior is important for the developer of e-commerce application and website because previous buyers of e-commerce behave differently from newcomers who are still new to the particular website. In particular, the correlation of past purchasing with the social presence is unclear.

Intention to purchase

Nowadays the world is more interested about community whenever the people intend to make a purchase decision. The current religious, ethical, and environmental regressions have compelled the people to think carefully of anything is serious or not, if it bear lies or truth (Shah et al; 2011). Intention to purchase is a kind of decision made by the buyer in which he/she verifies a brand in particular and neglect other brands. Constructs like trust in something before purchasing a brand and continuing to purchase a brand aids the scope of consumer's intentions to purchase (Porter, 2009), while Schoen (2004) found a type of loyal buyers whose purchasing decision is insensible to pricing, and buyers investing money in the brand that satisfy their needs which they extremely trust.

The intention to purchase is one the main drivers that tend buyers to continue in payment transaction and finishing with buying products or services. Intention to act is a psychological behavior. Fishbein and Ajzen (1975) used the relationship between cognition, intention and behavior as their premise in the theory of reasoned action, and they found that: "intentions are jointly determined by the person's attitude and subjective norm concerning the behavior". The intention to purchase can be classified as one of the components of consumer's cognitive behavior on how an individual intends to buy a specific product or service. Laroche Zhou (2009) suggests that variables such as customers' trust in buying a particular brand can be used to measure the

intention to purchase of consumer. The trust factor can include the customer's interest as part of the overall decision-making process in determining the intention of buyers.

The purpose of this research

The fundamental factors to buyer's behavior such as Trust, Past Experience, and Social Presence, and their relationship to intention to purchase are very important for e-commerce systems. Online purchasing has unique features that make it different from the traditional shopping process. Therefore, understating the main factor that enhances the intention to purchase of buyer's will effect on e-commerce. This study seeks to investigate the relationship between Trust and intention to purchases online, in addition to that investigate two other factors Past Experience & Social Presence on Intention to purchase.

In this paper we argue that "Trust" is the strongest factor and considered as an initial factor in the prediction of purchasing intentions. This paper foresees that "Trust" needs to be included in an empirical model and investigate its effect on intention to purchase online. The other two factors Past Experience & Social Presence are moderate factors and both with the power of Trust factor influence the intention to purchase online by the buyers and change their purchasing behavior.

Significance of the Research

The significance of this study comes from its logical evaluation to the impact of Trust, Past Experience, and Social Presence on the intention to purchase online of. The study consider trust as the main driver that improve the business of online sellers through providing trust dimensions in e-commerce applications that let buyers continue in payment with full confidence. This paper critically identify the main hinders that affect the level of Trust among online shoppers and then set recommendations for companies doing business through e-commerce to remove the factors that affect Trust and increase revenues.

Theoretical Framework and Hypotheses

Following the long tradition in studying buyers' behavior, we assume that a person's behavior is affected by his/her intentions and personal attitude. The theory of reasoned behavior was the most theory frequently used by scholars to evaluate consumer-behavior that build the intention to purchase (Ajzen and Fishbein, 1980) and its extension, the planned behavior theory (Smith et al., 2008; Chih& Su-Chao, 2005). However, it is not clear how these theories identified the range of behaviors found in diverse social networks relevant to online purchasing. This study examines the relationship between past experience and intentions to purchase in its specific social presence. We use four constructs to explore this relationship: Trust, Social Presence, Past Experience, and Intention to Purchase.

The study assumes that "Past Experience" & "Social Presence" are reinforcing factors with "Trust" that enhance the intention to purchase online. Social Presence represents the social context by the notions of social presence and trust.

This study assumed "Trust" and "Experience to purchase online" as the independent variables, and the social presence in e-commerce is a moderate variable, while, and "Intention to Purchase" is the dependent variable.

H1. Past experience to purchase online is positively correlated to Trust.
H2. Trust is positively correlated to intention to purchase online.
H3. Social presence is positively correlated to Trust.
H4a. Past experience to purchase online is positively correlated to intentions to purchase online. Similarly; past experience to purchase online relate to the uncertainty of making the interaction with the website. Trust is the strongest factor that is likely to increase buyer's intentions more than other factors. All these factors effects will, generate a stronger intention to purchase among buyers online. Trust, as shown below, reducing uncertainty significantly to enable the complex decisions involved in online purchasing.

We therefore expect higher trust to directly impact intentions to purchase, which represent a decision in the face of uncertainty. Past experience, social presence and trust affect the intention to purchase. Accordingly we suggest the following hypotheses:
H4b. Social presence is positively correlated to intentions to purchase online.
H4c. Trust is positively correlated to intentions to purchase online.

In order to examine the concurrent effects of Trust, Past Experience of purchasing online, and Social presence on intention to purchase we suggested a model that contains these elements (Fig-1).

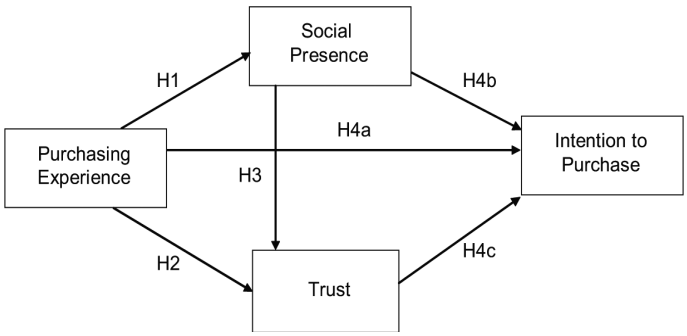


Fig-1: The relationships between Trust, Past Experience, and Social Presence on Intention to purchase

RESEARCH METHODOLOGY

To address this need, we have conducted a meta-study of the empirical literature on trust in e-commerce systems. This area of research is still immature, and hence our meta-analysis is qualitative rather than quantitative. We identify the major theoretical frameworks that have been proposed in the literature, and propose a qualitative model incorporating the various factors that have been empirically found to influence consumer trust in e-commerce. As this model is too complex to be of practical use, we explore subsets of this model that have the strongest support in the literature, and discuss the implications of this model for Web site design. Finally, we outline key conceptual and methodological needs for future work on this topic

Data were collected from 119 employees working in various high-tech companies, who use the internet in their daily work for knowledge sharing, surfing sites related to their work, and emailing. By high-tech companies we mean those that emphasize invention and innovation and

employ a relatively high percentage of scientists and engineers in their workforce. About 65 percent of the participants had past experience to purchase online via the internet in the previous four years. Most of them (77 percent) were men, in terms of qualification of education, most of them held a university degree. Respondents were asked to answer a set of questions based on their "best purchasing experience you had via the internet".

We develop and test a model that explains the social context of online purchasing intentions by looking at past purchasing and these two constructs of social context. This model has implications for both academia and business.

RESULTS AND DISCUSSION

The effect of Trust and Social Presence on Intention to Purchase

In order to investigate the relationships between the dependent variable "Intention to purchase" and the independent variable "Trust" and "Social presence" according to hypotheses H1 & H1, the zero-order correlations was applied, which is used to measure the association between two variables or all predicted variables with the respondents' intention to purchase via the internet are presented in Table-1.

Table 1: Correlation between Trust and Social presence with Intention to Purchase online

Items	Intention to purchase	Trust	Social presence
I accept to my credit card to purchase from e-commerce website	0.86	0.20	0.14
I accept to buy from other websites as well	0.84	0.23	0.02
I may back again and buy from the same website	0.82	0.28	0.28
I recommend to buy from this website	0.73	0.29	0.43
I feel completely trust in the purchasing process	0.28	0.89	0.21
I feel completely trust in because of website's efficiency	0.19	0.89	0.10
I feel completely trust when providing personal details to the website	0.32	0.73	0.28
I understand that other buyers are present on the same website I used to buy from	0.03	0.14	0.80
I feel the people behind this website	0.16	0.26	0.80
I feel the efficiency of service and availability of other customers	0.39	0.08	0.67
Variance (%)	52.04	12.64	11.74

Table-2 shows that all hypotheses of the study (H1, H2, H3, and H4) were confirmed and there is strong correlation between the study variables as expected. Respondents who had past experience in purchasing online showed a higher perception of "Social Presence" when navigating the website (r = 0.27), and the respondents showed a higher degree of trust to experience e-commerce purchasing (r = 0.26), and this result is confirming H1 & H2, respectively. Respondents who perceived a higher "Social Presence" when navigating the website showed a higher degree of trust and wish to proceed on payment transaction with full confidence (r = 0.46), however this result confirming hypothesis (H3). Reducing social uncertainty would be through

increasing social presence, predicting, and controlling the behavior of other people is a central motivating force of human behavior. When rules and customs are not sufficient, people rely on trust and familiarity as primary mechanisms to reduce social uncertainty. The social presence on the dimensions of trust, especially benevolence, has an ultimate contribution to online purchase intentions because of trust (Gefena&Straubb, 2009)

Table 2: Means, Standard Deviations, and Correlations factors to verify the study hypothesis (H1, H2, H4, and H4a, H4b and H4c respectively)

Variables	Mean	Standard Deviation	Past purchase	Social Presence	Trust
1. Past experience to purchase online (1 = yes)	1.41	0.49	0.27 **		
2. Social presence (scale 1-5)	2.90	1.12			
3. Trust (scale 1-5)	3.32	1.19	0.26 **	0.46 **	
4. Intention to purchase in the future (scale 1-5)	3.37	1.14	0.49 **	0.49 **	0.58 **

In addition to that respondents showed a higher intentions to purchase online in the future when they had previous experience in purchasing online (r = 0.49), a higher "Social Presence" (r = 0.49) and had higher trust in the website when proceeding in the purchase process (r = 0.58), however this result is confirming study hypothesis H4a, H4b and H4c, respectively).

Interconnection between Trust and Social Presence

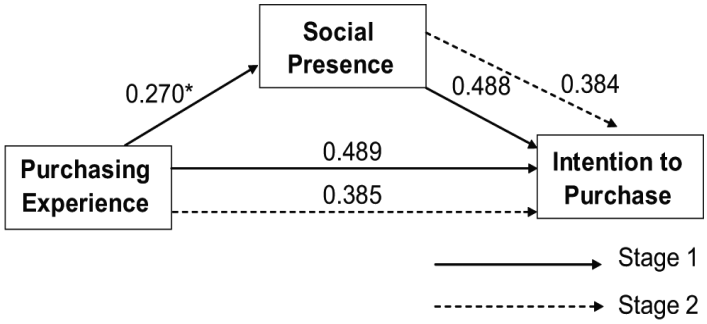
In order to test the effect of "Social Presence" and "Trust" on the relationship between past experiences of purchasing online and intentions to purchase in the future we achieved multiple tests as suggested by Baron and Kenny (1986). The approach to know the effect depends on achieving three conditions: first, a strong correlation between the dependent variable and independent variable; second, a strong correlation between the independent variable and intermediary variable and; and third, if the correlation between intermediary and the dependent variable is strong and the correlation between the dependent and independent variables tempt to be strong, then full intermediary is obtained whereas if the latter correlation decreases but remains strong, partial intermediary is obtained. The results of the mediation test are presented in (Figs 2 and 3) below.

The Effect of Social Presence and Past Experience on Intention to Purchase Online

The first condition for a strong correlation between past experience to purchase online and intention to purchase in the future, which was met (β= 0:49), and this result confirming the study hypothesis H4a. The second condition requiring a strong correlation between past experience to purchase online and social presence, which was met (β= 0.27), and this result confirming study hypothesis H2.

The third condition requiring a strong correlation between social presence and the intention to purchase (β= 0.38), and there was a decrease from β= 0.49 - β= 0.38 in the relationship between past experience to purchase online and intention to purchase online, which indicates that there was

partial intercession of social presence between past experience to purchase online and intention to purchase online, as shown in Fig-2 below:



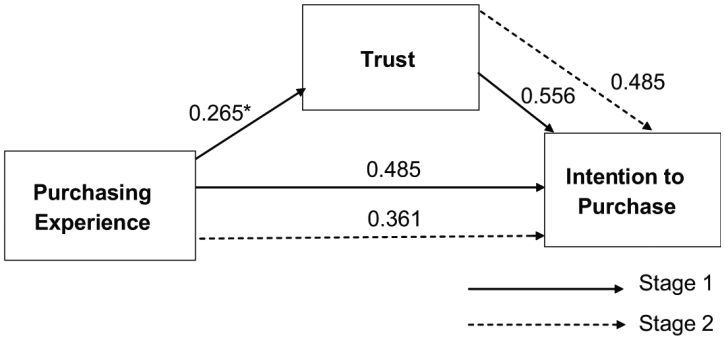
Note: *Figures indicate *β* coefficients

Note: Figures indicateβ coefficient

Fig-2: Mediation of social presence between purchasing experience and intention to purchase

The Effect of Trust on Intention to Purchase

The first condition for a strong correlation between past experience to purchase online and intention to purchase online was met (β= 0.48), confirming study hypothesis H4a. The second condition requiring a strong correlation between past experience to purchase online and trust, also was met (β= 0.26), and this result confirming study hypothesis H1. The third condition requiring a strong correlation between trust and intention to purchase online (β=0.48), while there was a decrease from (β= 0:48 to β= 0.36) in the correlation between past experience to purchase online and intention to purchase online, however this result indicates a moderate level of trust between past experience to purchase online and intention to purchase online, as shown in Fig-3 below:



Note: *Figures indicate *β* coefficients

Note: Fig indicate β coefficient

Fig-3: Mediation of trust between purchasing experience and intention to purchase

Table 3: Regression results for intention to purchase by past experience to purchase online, trust, and social presence

B		S.E.	β	t	Sig.	(,)	DR
(Constant) "Social presence"	2.53	0.39	0.30	6.40	0.00 0.00 0.00 0.01		0.24 0.22 0.04
(1-5), "past experience to	0.70	0.16	0.36	4.26			
purchase online" (1 = yes),	0.34	0.07	0.25	4.67			
"Trust" (1-5)	0.26	0.08		3.28			

DISCUSSION

The Trust and Past Experience have been shown the most influential factors with high reliably to predict buyer's behavior, primarily in a stable e-commerce platform (Bagozzi et al., 2000; Oellette and Wood, 2007). Online purchasing is not a stable framework; to many buyers' it is threatening and maybe considering security penetrative. Buyers are very caution to buy online even buyers who have strong experience in purchasing online. Therefore the impact of Trust is strongest comparing to other factors, and this was identical with the result of the study. We evaluated the perception of participant to Trust, Past Experience and Social presence and their impression on these three factors, and the result showed that Trust (47%) is the most influential factor, followed by Past experience (33%) and Social Presence (20%). As shown in Fig-4 below. This means that buyers pay more attention to Trust elements in e-commerce before depending on their past experience or check the level of social presence in the web site.

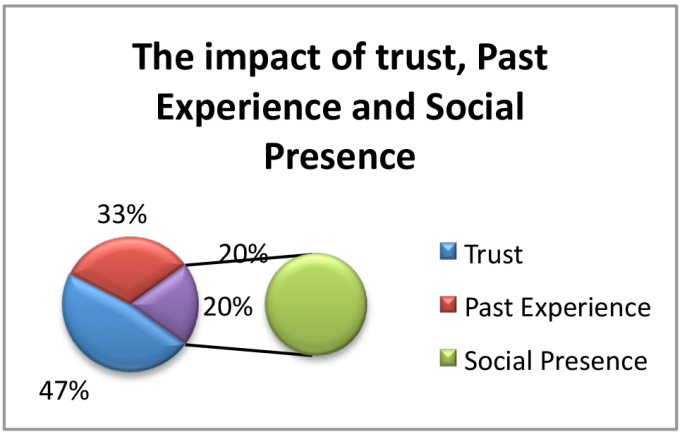


Fig-4: The perception of buyers towards Trust, Past Experience and Social Presence

The social context of physical or traditional shopping has a strong impact on buyers' behavior; however it is not in the same level in online shopping. Our findings showed that the social presence is important in affecting the intention to purchase by adding value to the products online through community share of user and visitors to the website. Moreover, the social context is correlated to the past purchasing experience; thus a view of the social presence in which it changes with buyer's experience is likely to be a considerable factor in determining the behavior of online shopping. We examined the impact of (Trust, Past Experience and Social presence) on Intention to Purchase from the perspective of participant, and the result showed that Trust (42%) is the strongest factor that affects the intention of buyers to purchase online, followed by Past experience (31%) and Social Presence (27%). As shown in Fig-5 below.

The result is identical with our primary assumption that Trust is the most influential factor, followed by Past Experience and then Social Presence. However the combination of all factors together contributes to stronger intention to purchase by online buyers.

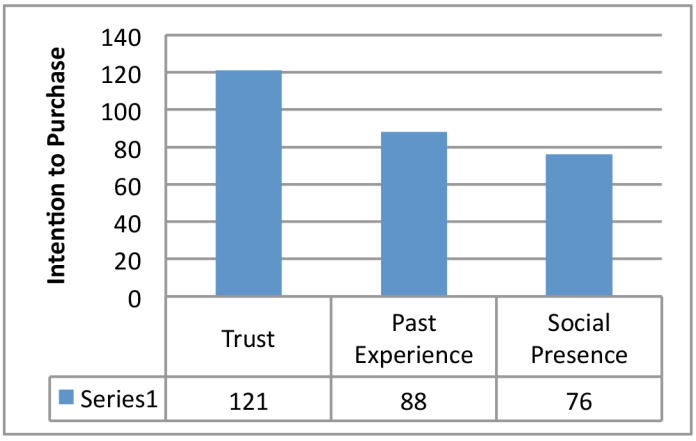


Fig-5: The relationship between Trust, Past Experience and Social Presence with the intention to purchase

CONCLUSION

The study concluded that three factors; Trust, Past Experience and Social Presence have strong relationship with the intention to purchase online and all have positive correlation with buyer's intentions and behaviors. The study found that Social presence positively influences online instruction through enhancement of social networks in e-commerce; however, frequency of participation does not represent high social presence." In both a quantitative and qualitative analysis of respondents we found that social presence to achieve positive impact, online communication was more strongly related to experimental and organizational skills of respondents, As a result, Trust was the strongest factor that affect the intention to purchase online and in the decision-making process as well, while the reason for this result of trust is that both knowledgeable processes and background of consumers may play a role in the formation of trust to e-commerce.

Recommendations for Future Studies

This study limited to evaluate the impact of three factors (Trust, Past Experience and Social presence), where there are other factor could influence the intention to purchase and should be evaluated in future studies such as (the usability of e-commerce, Information quality, and Payment security).

The study emphasizes that further evaluation to the impact of demographic factors such as gender, age, and intelligence of buyers may affect their intention to purchase and behavior.

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Abdalslam. S. Imhmed. Mohmed
Faculty of Science and Technology
University Science Islam Malaysia (USIM)
abdul.abdo@yahoo.com
0060126777417

Mohd Zalisham Jali
Faculty of Science and Technology
University Science Islam Malaysia (USIM)
Zalisham@usim.edu.my
0060193891103

Nurdiana Binti Azizan
Faculty of Science and Technology
University Science Islam Malaysia (USIM)
Nurdiana@usim.edu.my
0060133433103

46

State-Feedback Controller Based on Pole Placement Technique for Inverted Pendulum System

S. Jaafar, M. H. Jali & F.N. Zohedi

ABSTRACT

This paper presents a state space control technique for inverted pendulum system using simulation and real experiment via MATLAB/SIMULINK software. The inverted pendulum is difficult system to control in the field of control engineering. It is also one of the most important classical control system problems because of its nonlinear characteristics and unstable system. It has three main problems that always appear in control application which are nonlinear system, unstable and non-minimumbehavior phase system. This project will apply state feedback controller based on pole placement technique which is capable in stabilizing the practical based inverted pendulum at vertical position. Desired design specifications which are 4 seconds settling time and 5 % overshoot is needed to apply in full state feedback controller based on pole placement technique. First of all, the mathematical model of an inverted pendulum system is derived to obtain the state space representation of the system. Then, the design phase of the State-Feedback Controller can be conducted after linearization technique is performed to the nonlinear equation with the aid of mathematical aided software such as Mathcad. After that, the design is simulated using MATLAB/Simulink software. The controller design of the inverted pendulum system is verified using simulation and experiment test. Finally the controller design is compared with PID controller for benchmarking purpose.

Keywords: State-feedback controller, pole placement technique, inverted pendulum.

ABSTRAK

Kajian ini menerangkan kawalan teknik 'state-space' untuk sistem bandul songsang menggunakan simulasi dan eksperimen menggunakan perisian MATLAB/SIMULINK. Bandul songsang adalah sistem yang sukar untuk dikawal dalam bidang kejuruteraan kawalan. Ia juga merupakan salah satu masalah klasik yang paling penting kerana ciri-ciri linear dan sistem tidak stabil. Ia mempunyai tiga masalah utama dalam aplikasi kawalan iaitu sistem tak linear, tidak stabil dan bukan minimum sifat sistem fasa. Projek ini akan menggunakan pengawal maklumbalas suap balik berdasarkan teknik perletakan kutub yang mampu untuk menstabilkan bandul terbalik pada kedudukan menegak. Spesifikasi rekabentuk yang dikehendaki ialah 4 saat penyelesaian masa dan 5% lajakan diperlukan untuk digunakan dalam pengawal suap balik penuh berdasarkan kepada teknik perletakan kutub. Pertama, model matematik sistem bandul terbalik diperolehi untuk mendapatkan perwakilan ruang keadaan sistem. Kemudian, fasa reka bentuk p Pengawal suap balik boleh dilakukan selepas teknik linear dilakukan untuk persamaan linear dengan bantuan perisian bantuan matematik seperti 'Mathcad'. Kemudian, reka bentuk disimulasi dengan menggunakan perisian 'MATLAB / SIMULINK'. Akhirnya rekabentuk pengawal sistem bandul songsang disahkan menggunakan simulasi dan ujian eksperimen. Sementara, kaedah pengawal 'proportional-Integrative-derivation'(PID) melalui teknik automatik 'tune' adalah untuk melihat hasil prestasi.

Kata kunci :Kawalansuapbalik, teknikperletakankutub,bandulsongsang

INTRODUCTION

The control of an inverted pendulum is a well-known and a challenging problem that serves as a popular benchmark in modern control system studies. The inverted pendulum is a highly nonlinear and open-loop unstable system [3]. This means that standard linear techniques cannot model the nonlinear dynamics of the system. When the inverted pendulum is positioned upright, it could falls over quickly. The characteristicsof the inverted pendulum make control system engineering morechallenging [4].

An appropriate control system need to be applied to balanced it in a vertical upright position. Therefore control system is designed using state feedback control method by several state space control techniques. In order to ensure the stability of the inverted pendulum, a good control theory is to design a good controller. This research is conducted in several stages which are literature study, mathematical model equation, controller design, simulation and experimental test. The simulation and experiment will be implementing in Matlab-Simulink software.

This paper is organized as follows. Section II describes in detail about the inverted pendulum system. Section III explains thoroughly the control techniques that involved in the research works. Section IV presents the results and discussion of each control technique as well as the comparison among them using Matlab/Simulink simulation. Finally, Section V describes the conclusion of this research work.

INVERTED PENDULUM SYSTEM

The state feedback controller based on pole placement technique which is capable in stabilizing the practical based inverted pendulum at vertical position [1]. The inverted pendulum system is a classical control problem that widely used in control laboratories. It is widely used as a benchmark for testing control algorithms i.e PID controller, neural networks, fuzzy control and etc. The system model needs to be represented in state space form before designing the controller [2].
Fig. 1 shows a schematic drawing of simplified rotary inverted pendulum. A state space representation is not unique,since different choices of state variables leads to a different representation of the same system. The rod and the arm has a mass, *m* and length,*l*. If we assume $\theta_2\theta_2 = 0$, $\cos\theta_2\theta_2 = 1$ and $(\dot{\theta}_2\dot{\theta}_2)\theta_2\theta_2 = 0$, so the linearized model can be obtain[2].

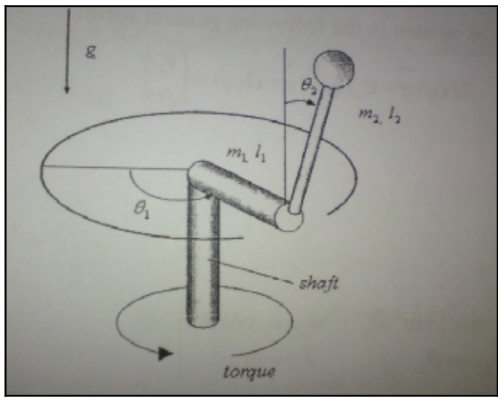

Figure 1: Schematic drawing of simplified rotary inverted pendulum

Where the system variables and parameters can be described as follows;

$m_1 m_1$: mass of arm
$m_2 m_2$: mass of pendulum
$l_1 l_1$: length of arm
$l_2 l_2$: length of pendulum
$C_1 C_1$: distance to the center of mass of arm
$C_2 C_2$: distance to the center of mass of pendulum
$J_1 J_1$: inertia of arm
$J_2 J_2$: inertia of pendulum
$\theta_1 \theta_1$: angular displacement of arm
$\dot{\theta}_{11}$: angular velocity of arm
$\theta_2 \theta_2$:angular displacement of pendulum
$\dot{\theta}_2 \dot{\theta}_2$:angular velocity of pendulum
$\tau_1 \tau_1$: applied torque
G: gravitional acceleration

The linearized model is obtained as shown[12[;

$$\dot{x}_1 \dot{x}_1 = x_3 x_3$$

$$\dot{x}_2 \dot{x}_2 = x_4 x_4$$

$$\dot{x}_3 = \frac{(m_2 c_2{}^2 + J_2)\frac{k_b}{R_m} u - m_2{}^2 \, c_2{}^2 g x_2 - (m_2 c_2{}^2 + J_2)\frac{k_b k_t}{R_m} x_3}{(m_2 l_2{}^2 + J_2)(m_2 c_2^2 + J_2) - (m_2 l_2 c_2)^2}$$

$$\dot{x}_4 = \frac{-m_2 l_2 c_2 \frac{k_b}{R_m} u + (m_2 l_2^2 + J_2)(m_2{}^2 \, c_2{}^2 g x_2 + m_2 l_2 c_2 \frac{k_b k_t}{R_m} x_3}{(m_2 l_2{}^2 + J_2)(m_2 c_2^2 + J_2)) - (m_2 l_2 c_2)^2}$$

Table I: Parameter's value of mechanical and electrical system of inverted pendulum

Physical quantity	Symbol	Numerical value
Mass of arm	m_1	0.056 kg
Length of arm	l_1	0.16 m
Distance to arm Center of mass	C_1	0.08 m
Inertia of arm	J_1	0.00215058 kg-m2
Mass of pendulum	m_2	0.022 kg
Lenght of pendulum	l_2	0.16 m
Distance to pendulum Center of mass	C_2	0.08 m
Inertia of pendulum	J_2	0.00018773 kg-m2
Armature resistance	R_m	2.5604 Ω
Back-emf constant	K_b	0.01826 V-s/rad
Torque constant	K_1	0.01826 N-m/A

Thus, linear state space form to get the following state space equation;

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -7.1247 & -0.0963 & 0 \\ 0 & 59.3267 & 0.0741 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 7.0002 \\ -5.3847 \end{bmatrix} e$$

$$y = [0\ 1\ 0\ 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$

THE CONTROL TECHNIQUES

State-feedback controller based on pole placement technique is used to ease the controller design. The design specification requirement which is consisting of 4 seconds settling time and 5% overshoot is design target in the inverted pendulum system. To produce the best output results, the best location for the non dominant poles need to be investigated. The output result might be improved when the poles is relocated at a more negative eigenvalues location[7][8]. The desired characteristic equation can be accomplished by considering the design target specification the inverted pendulum system. The overshoot and settling time design target is shown in Table II.

Table II: Design specification

No.	Design target	Cart position	Pendulum angle
1	Settling time	4 seconds	4 seconds
2	Overshoot	5%	5% x 2π=0.3142rad

From the design target, the desired dominant poles may be derived as follow;

$$\xi = \frac{-\ln(Os\%/100)}{\sqrt{\pi^2 + \ln^2(Os\%/100)}} = \frac{-\ln(0.05)}{\sqrt{\pi^2 + \ln^2(0.05)}} = 0.69$$

$$ts = \frac{4}{\zeta \omega n} \Rightarrow \omega n = \frac{4}{\zeta ts} = \frac{4}{(0.69)(4)} = 1.45$$

$$S_1, S_2 = -\zeta\omega n \pm j\omega n\sqrt{1-\zeta^2} = -0.69(1.45) \pm j1.45\sqrt{1-0.69^2} = -1 \pm j$$

Table III: Non -dominant poles locations and their gain

No	Pole location	K_1	K_2	K_3	K_4	Gain block
1	-3±3j	-2.3877	-37.8929	-1.2872	-4.6269	K_a
2	-5±5j	-26.5298	-129.0775	-7.9728	-15.9182	K_b
3	-7±7j	-116.9965	-342.8849	-24.5275	-40.0395	K_c
4	-10 ± 10j	-1.0612	-57.3395	-1.1811	-5.6032	K_d

The poles are relocated at a more negative eigenvalues location to see whether the output result might be improved or not[5][6]. The simulation is performed based on the Simulink block diagram shown in Fig. 2. The controller gain is generated as Table III.

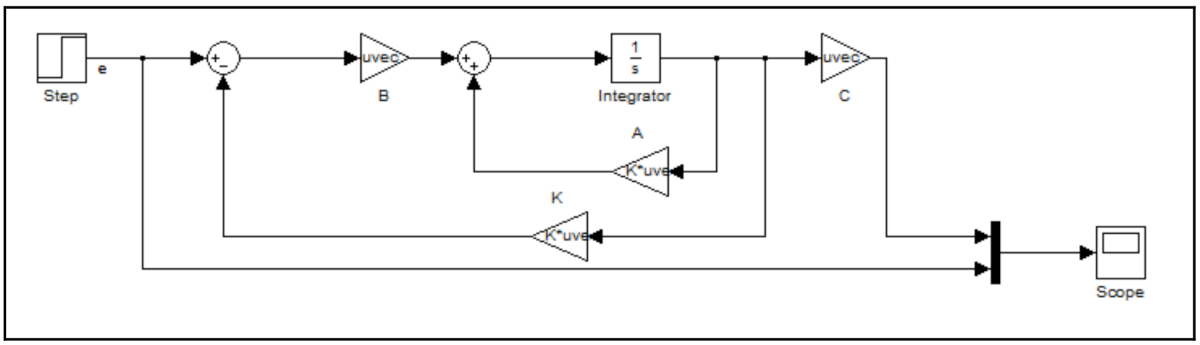

Figure 2: Block diagram of full state feedback (pole placement technique)

RESULTS AND DISCUSSION

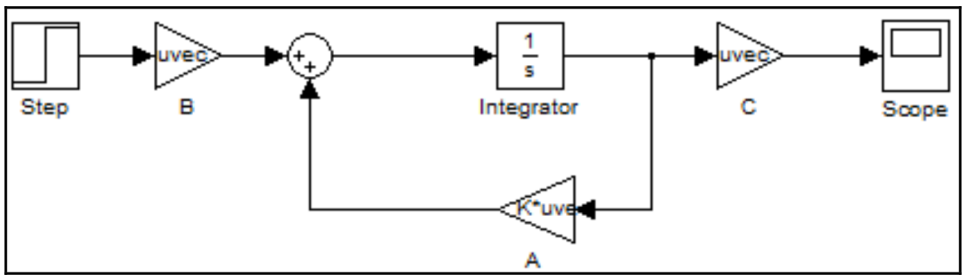

Figure 3: Block diagram of the open loop response of the system

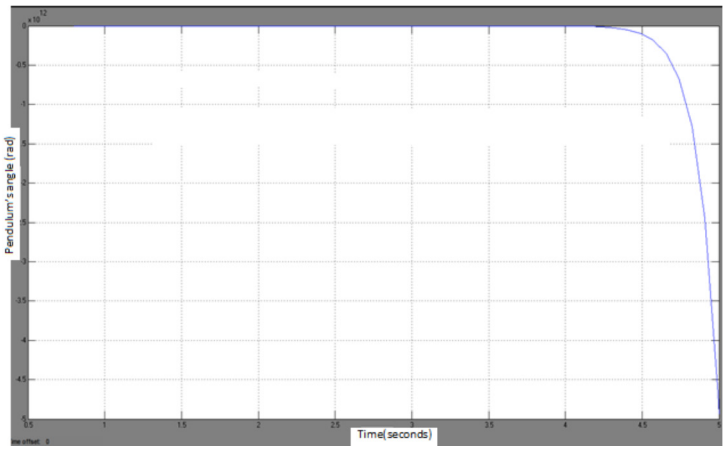

Figure 4 : Output response of the inverted pendulum system

From the Figure 4.2, it is obviously clear that the system is unstable. Hence, in order to make the system stable, the control system plays the role to stabilize the inverted pendulum system as well as achieving performance design target.

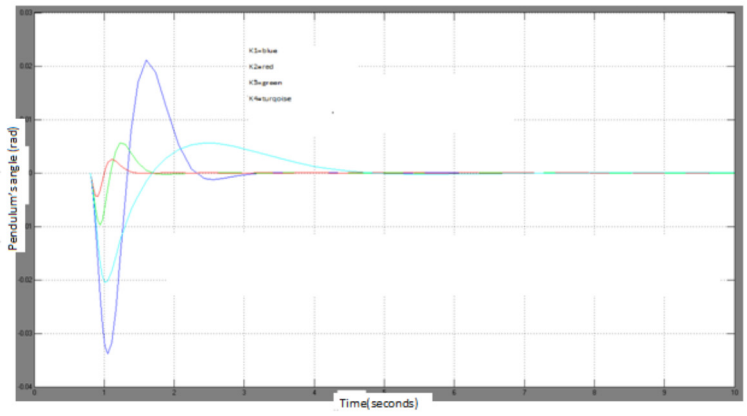

Figure 5: Results of the pendulum's angle between the non-dominant poles

Table IV: Result of the best gain values for simulation result

No	K1	K2	K3	K4
1	-2.3877	-37.8929	-1.2872	-4.6269

From Figure 5, it shows that the four output result that represent different gain values of several non-dominant poles location, the first block diagram is represented by the yellow line. Non-dominant poles at 1st pole location (-3±3j) produce the highest overshoot but settled within 4 seconds. Second pole location (-5±5j) is represented by the purple line which is less than 0.01 rad and settled at 2 seconds. While non-dominant poles at third pole location (-7±7j) is represented by green line. It takes less than 0.01 rad and settled in two seconds.

Lastly the fourth pole location (-10±10j) is represented by the red line. It shows the slowest settling time within 5 seconds. Since the purple and green line are about the same, the first pole location is chosen because it has the best trade-off between overshoot and settling time . It can be seen that the yellow line shows the highest overshoot and settled at 4 seconds. Difference from simulation, experimental test need to considerseveral factors such as hardware limitation to obtain the best output result. The real experiment is conducted using MATLAB/Simulink and Microbox at Control, Instrumentation and Automation Laboratory .In the next section, the output result based on real experiment for inverted pendulum system will be analyzed.

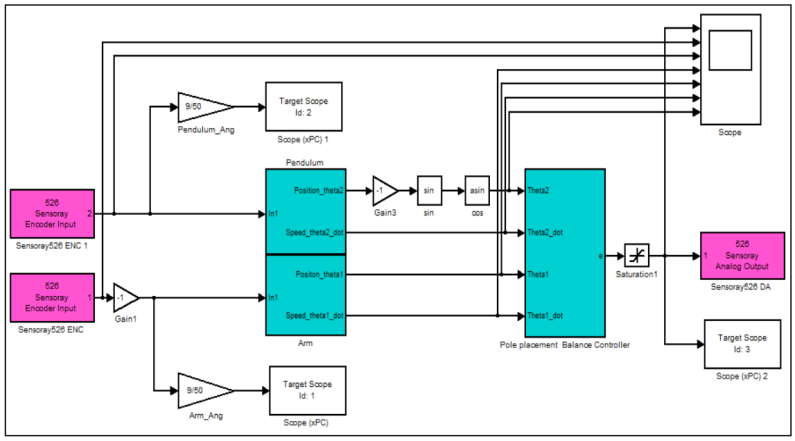

Figure 6: Block diagram of state feedback controller based on pole placement technique in real experiment

From Figure 7, it can be seen that the overshoot of pendulum's angle is 3.9% and the settling time is 8 seconds. Based on the experimental observation, the controller capable in stabilizing the inverted pendulum system in the vertical upright position even if a small force is applied to the pendulum by tapping finger to it. However when the pendulum is released from its initial upright postion, less vibration occured before the pendulum start to stabilize.

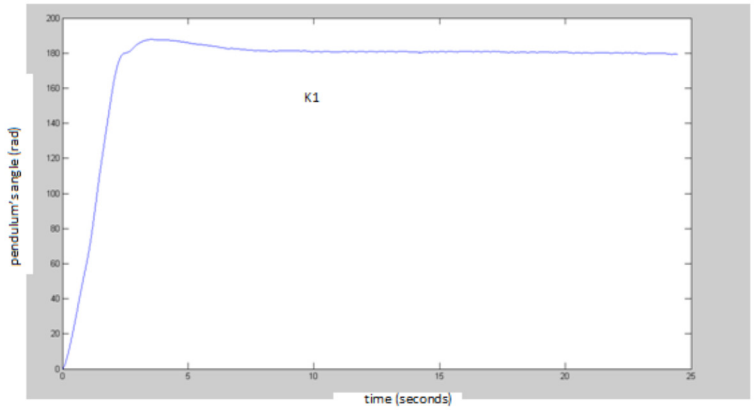

Figure 7: Experimental output result of the state feedback controller.(1st gain)

From Figure 8, it can be seen that the overshoot of pendulum's angle is 6.7% and reaches 5 seconds settling time to balance it in the vertical upright position. Based on the experimental observation, the controller also capable in stabilizing the inverted pendulum system even if a small force is applied to the pendulum by tapping finger to it. When the pendulum is released from its initial upright postion, more vibration occured compared to the 1st gain values before the pendulum start to stabilize.

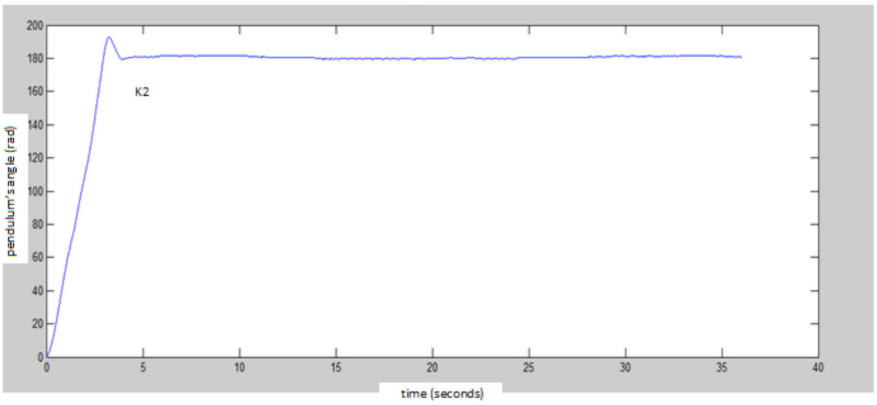

Figure 8: Experimental output result of the state feedback controller.(2nd gain)

From Figure 9, it shows that the output result of the state feedback controller based on third gain values. It is clearly show that the inverted pendulum system required more than 10 seconds to settle and to stabilize in the vertical upright position. Based on the experimental observation, the controller is not capable to stabilizie the inverted pendulum system in the vertical upright position for a long period. It will falling down after 15 seconds and can not compensate with a small force is applied to the pendulum by tapping finger to it.

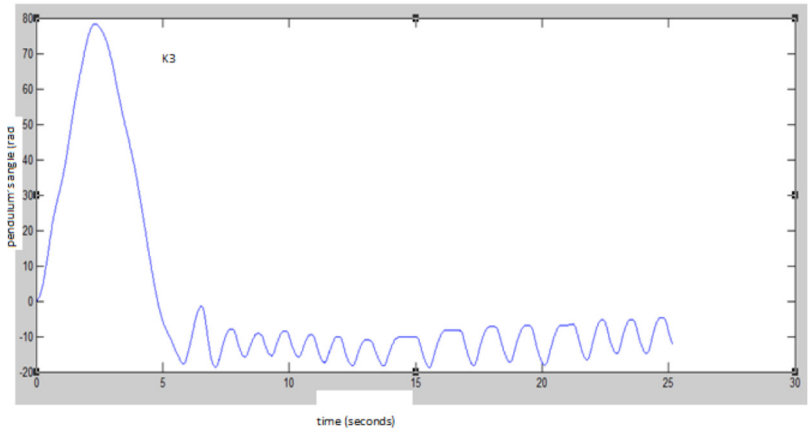

Figure 9: Experimental output result of the state feedback controller.(3rd gain)

From Figure 10, it shows that the output result of the state feedback controller based on fourth gain values. It is clearly shows that the fourth gain values are worse than the third gain values. Based on the experimental observation, the controller is not capable to stabilizie the inverted pendulum system in the vertical upright position for a long period. It will falling down after 15 seconds and can not compensate with a small force is applied to the pendulum by tapping finger to it.

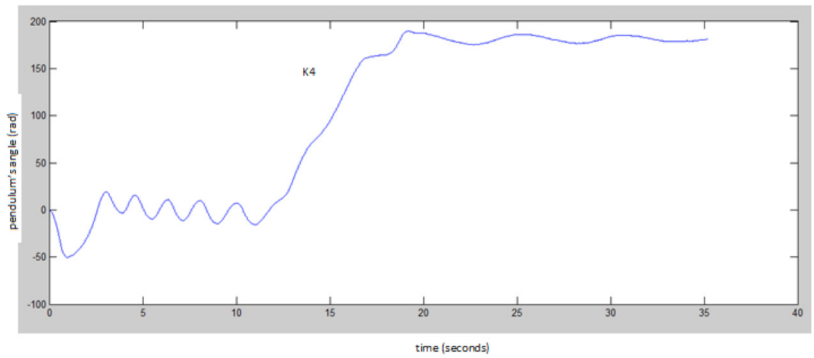

Figure 10: Experimental output result of the state feedback controller.(4th gain)

Table V: The output result of the state feedback controller based on fourth gain

No	Pole location	Gain values	simulation		experiment	
			Os(%)	Settling time (seconds)	Os(%)	Settling time
1	[3+3j -3-3j 5+5j5-5j]	1st	0.02	4	3.9	8
2	[-5+5j -5-5j 10+10j -10-10j]	2nd	<0.01	1	6.7	5
3	[-7+7j -7-7j -15+15j -15-15j]	3rd	.>2	2	0.04	>10
3	=[-1+j -1-j -10+10j -10-10j]	4th	>0.005	5	0.05	>15

From Table V, based on the experiment, the best ouput result is the first gain values because it has the best trade off between settling time and overshoot result as well as produce less vibration when the the pendulum is released from the initial upright postion. It also capable to stabilize the inverted pendulum system at all-time even with small forces is applied to it by using finger tap. Table 4.2 also shows that there is allignment between simulation and experiment test result. In overall, both the experiment and simulation result shows that the first gain values has the best performance.

However there is deviation between the experiments and simulation result because of several factors. In the experiment test, hardware limitation such as filter, motor and others is one of the factors that cause the experiment output result difference from the simulation result. In this research, both simulation and experiment test result need to be considered to decide on the most suitable pole location for the controller gain values[9][10].

Based on simulation result, it shows the output result have overshoot of 11% and settling time 68.2seconds.. By comparing the pole placement technique with PID tuning it is clearly shows that the PID controller has a worse performance than state feedback based on pole placement technique.

Table VI: Differences between simulation result, experiment test and simulation PID controller

ITEMS	Simulation	Experiment	Simulation PID controller
	1st gain	2nd gain	-
Settling time(sec)	4	5	68.2
Overshoot(%)	5	6.7	11

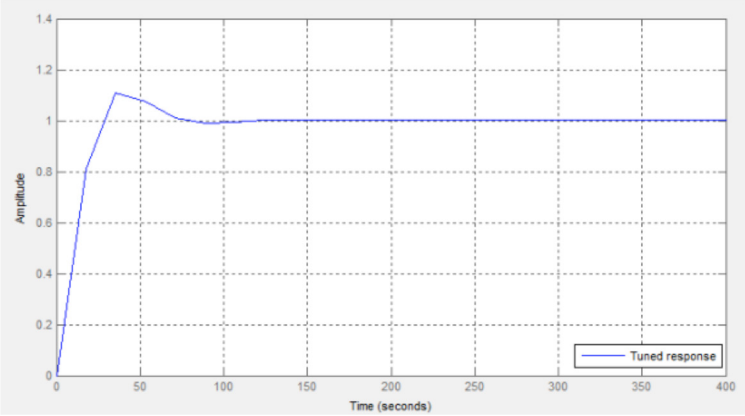

Figure 11: Output result of PID tune

Based on Table IV , the best gain values which is can capable to stabilize the system is second gain values. Although it show the overshoot at 6.7% but it can settle within 5 seconds in order to make the system stable in the vertical upright position. Therefore, by comparing the simulation result and experiment result the selection of poles need to be considered to obtain the best output result in term of overshoot and settling time. Other than that, simulation result based on

PID tuning show that it is not robust due the state feedback controller based on pole placement technique[11].

CONCLUSION

The best output result is selected by relocate the non- dominant pole location at several location.. As a result, the inverted pendulum is successfully stabilized and it can balance the inverted pendulum system at the upright position. The result shows that the inverted pendulum can be stabilizeby applying state feedback controller based on pole placement technique. Besides that, the simulation result based on PID tuning technique show it is not suitable to apply in the inverted pendulum system than the pole placement technique.

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S. Jaafara, M. H. Jali[b] & F.N. Zohedi[c]
Faculty of Electrical Engineering
UniversitiTeknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
[a]*safarwanijaafar@yahoo.com(06-5552331),*
[b]*mohd.hafiz@utem.edu.my(06-5552331),*
[c]*fauzal@utem.edu.my(06-5552279)*

47

Preliminary Study on Rainfall Interception Loss in an Artificial Tropical Forest

Azinoor Azida Abu Bakar, Muhammad Khairudin Khalil,
Siti Aishah Shamsudin & Jesuah Jimmy

ABSTRACT

The rainfall interception loss in an artificial tropical forest was investigated in this study. Nine months data was collected with 78 rainfall events, 73 events with throughfall and 72 events produce stemflow. Two study plots (Plot11 and Plot12) were selected at Bukit Lagong Forest Reserve, Kepong, Selangor. The measured interception losses are compared with the calculated intercepted losses compute by using original Gash model. The study show that the measured interception loss for Plot11 and Plot 12 is 305.8 mm and 269.11, and the calculated interception loss is 364.27 mm and 318.8 mm, respectively.

Keywords : Gash model, interception loss, rainfall, stemflow, throughfall.

INTRODUCTION

Interception loss had been studies for a few decades. In hydrological studies, interception loss is a major characteristic which is effects on site and catchment water balance (van Dijk and Bruijnzeel, 2001). Interception loss can be categorised as interception loss in forest due to the canopy structure and interception loss of building structure. This study, it is focus to the interception loss due to the canopy structure in the tropical forest. Interception loss can be refers to the amount of rainfall intercepted, stored and evaporation from the canopy (Deguchi *et al*., 2005). In other word, interception loss can be define as rain that fall to vegetation and evaporates without reaching the ground.

The Gash model is used to compute of interception loss in this study. The model was developed to make the prediction of interception loss on rainfall and canopy characteristics (Deguchi *et al*., 2005). The storm-based analytical model described by Gash (1979) demonstrated that the evaporation of rainfall intercepted by forest canopies can be estimated from the forest structure, the mean evaporation and rainfall rates and the rainfall pattern (Gash *et al*., 1995).

There are several parameters that have to determine in order to adapt Gash model to compute the interception loss. Precipitation is among the important parameters where it is influence by the canopy structure. Changes in canopy structure will alter the canopy storage capacity (S), (S), direct throughfall fraction (pp) and the ratio of evaporation to the rainfall intensity $(\bar{E}/\bar{R})$ $(\bar{E}/\bar{R})$ that influencing the interception loss (I) (I) (Pypker *et al*., 2005).

The focus of this study is to know interception loss of canopy structure by the tropical forest in Malaysia. The finding will be compared with the calculated value determine from original Gash model.

METHODOLOGY

Study Area

This study was conducted at Bukit Langong Forest Reserve at Forest Institutional Research Malaysia (FRIM) reserve forest Kepong, Selangor. Geographical location is $3^{\circ}15'3^{\circ}15'$N latitude and, $101^{\circ}37'101^{\circ}37'$E longitude. The FIRM forest compound is 485 hectares equally to $4{,}850{,}000m^2$ $4{,}850{,}000m^2$ and it is covered with primary lowland mixed dipterocarp forest and 78% of this forest reserve planted forest. **Figure 1** shows the boundary of Bukit Lagong forest belongs to FRIM and the shaded area which is denoted of Plot11 and Plot12 indicated the locations of the study area.

The two plots (Plot11 and Plot12) are then measured in area about $400m^2$ $(20m \times 20m)$ $400m^2$ $(20m \times 20m)$ where the interception loss canopy cover study conducted. Within the area of study for both locations, the trees above 10cm dbh (diameter at breast height) were identified, tagged and numbered. For the Plot11, 21 trees were identified that have dbh greater than 10cm whereas Plot12 consists of 20 trees. Plot11 is dominated by *Kulim* species while Plot12 is occupied with several species of three namely *Keladan, Keruing, Simpoh* and *Mempisang.*

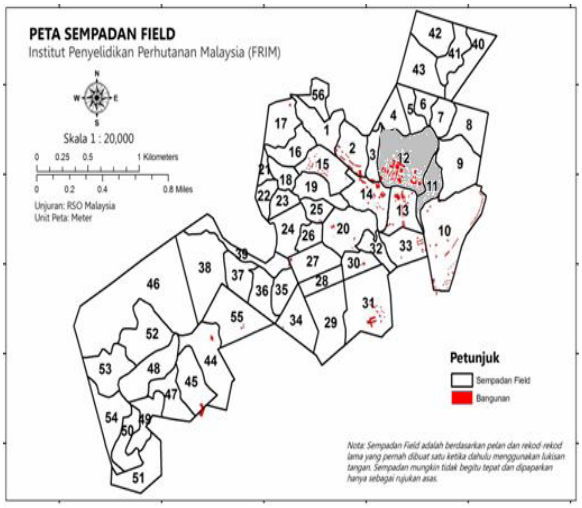

Figure 1: Location of the study area and FRIM forest boundaries.

Canopy Structure Measurement

Gross rainfall (P_g) (P_g) *Measurement*

Gross rainfall defines as the precipitation drops into the catchment or in an open area. In this study, the gross rainfall measured using the manual collector system where rain gauges was placed within 30 m from the study area and the rainfall data were collected in daily basis.

Throughfall $(T_f)(T_f)$ *Measurement*

The throughfall was measured by using 25 collectors with 225 mm diameter and 200 mm deep for both plots. The collectors of throughfall were placed at each of the plot grids with 5 meter interval. The volume of throughfall was measured by using measuring cylinder and it was collected daily basis.

Stemflow $(S_f)(S_f)$

The measurement of stemflow was done at the same plots as throughfall measurement. 15 trees for each plot were selected randomly based on the dbh and ease of access in setting up the stemflow collar. The collar method was adapted in measuring the stemflow where selected trees were fitted with spiral rubber collar.

Meanwhile, during the study period there is some problems occurred within the study period where on 14 April 2012 there is some changes in stemflow tank collector which actual tank collector capacity of 5.5 litres was change to 10 litres tank and replaced again with 25 litres tank capacity due to the overflow of stemflow from the selected trees for this study. On August 2012 there was no data collection in both sites because the research assistance was on leave.

$$Stemflow, S_f = \frac{1}{2}\left(\frac{(D_1+D_2)}{D_1} + \frac{(B_1+B_2)}{D_1}\frac{V_c}{A}\right) Stemflow, S_f = \frac{1}{2}\left(\frac{(D_1+D_2)}{D_1} + \frac{(B_1+B_2)}{D_1}\frac{V_c}{A}\right) \quad (1)$$

where,

$D_1 = total\ number\ of\ trees\ in\ plot$

D_2 = total number of uncollared trees

B_1 = total basal area of all trees (m^2/plot)

B_2 = basal area of uncollared trees (m^2/plot)

V_C = total basal area of all trees (liter/plot)

A = plot size (m^2)

RESULTS AND DISCUSSION

Gross Rainfall, P_g P_g

There are 78 events of gross rainfall recorded in both locations (Plot11 and Plot12). Out of 78 events of gross rainfall only 73 events in (Plot11) and 72 in (Plot12) events are produce measured throughfall and stemflow in and are producing measured throughfall and stemflow. The minimum gross rainfall recorded is 1.4 mm on September 28 whereas the extreme rainfall event recorded is 109.7 mm on April 18, 2012.

Figure 2 shows that the monthly summary of gross rainfall, throughfall, stemflow and interception loss within the study period. The wettest seasons was recorded on October until December which contributes the total rainfall of 1941 mm within the study periods. **Figure 2** shows the bar chart of monthly gross rainfall for both plots. The highest monthly rainfall recorded was 405 mm on November, 2012 whereas the lowest was recorded is 70 mm on June.

Throughfall Coefficient, *pp*

Throughfall coefficient, *p* determine by using linear regression of gross rainfall against throughfall, where the slope indicate prediction of *p*. The highest troughfall recorded for Plot11 and Plot12 are on April 18, 96.33 mm and 98.24 mm whereas the small value was recorded as 0.13 mm and 0.11 mm respectively. Total throughfall for Plot11 and Plot12 recorded within this study period was 1635 mm or 84.2% and 1671.2 mm or 86.1% of the gross rainfall. The monthly throughfall data is shown in **Figure 3**.

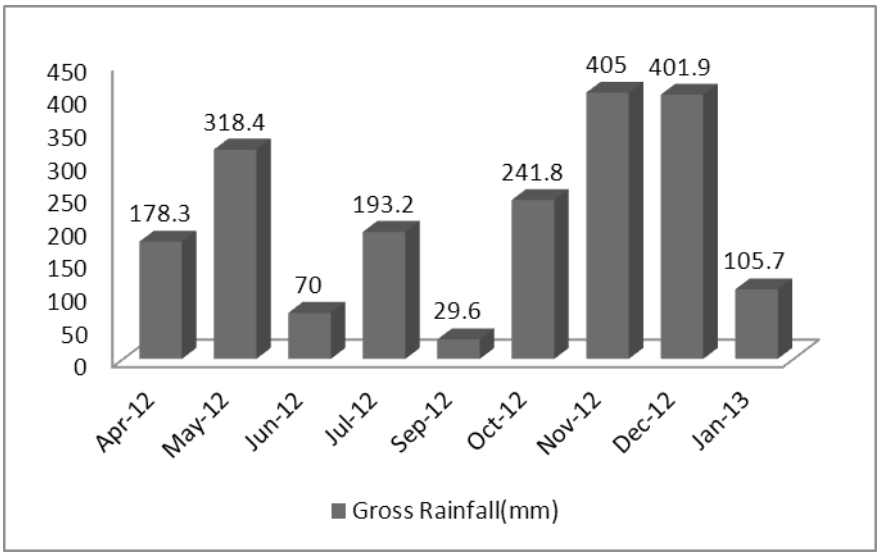

Figure 2: Monthly gross rainfall bar chart Plot11and Plot12

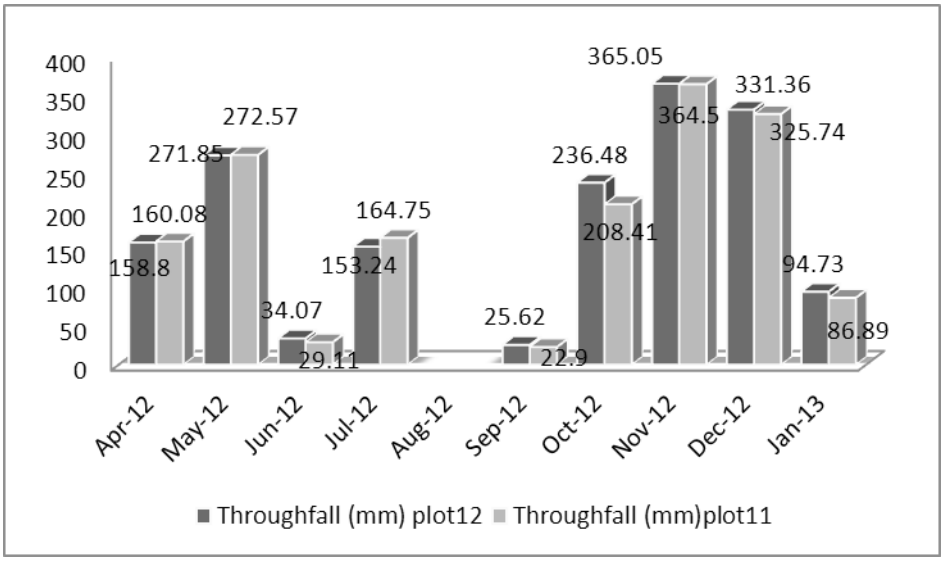

Figure 3: Monthly throughfall bar chart of Plot11 and Plot12

In the regression analysis, the threshold value of throughfall is >3mm which assume sufficient enough to saturate the canopy (Carlyle-Moses and Price, 1999). The threshold value for this study is higher than the other study because tropical forest canopy cover structure is large and contributes to high interception loss (Asdak *et al.,* 1998).

Figure 4, 5, 6 and 7 show the linear regression between these two components of interception loss. Based on the regression, the r^2r^2 value for Plot11 and Plot12 is 0.8626 and 0.8449 respectively. The value of throughfall coefficient, *p,* is 0.9269 for Plot11 and 0.8378 for Plot12. The present site can be comfortably predicted by Equation:

$$P_g = 0.9269T_f + 7.5P_g = 0.9269T_f + 7.5 \text{ for plot11 } (r^2 = 0.8626)r^2 = 0.8626) \quad (2)$$

$$P_g = 0.9692T_f + 4.122\ P_g = 0.9692T_f + 4.122 \text{ for plot12 } (r^2 = 0.8449)r^2 = 0.8449) \quad (3)$$

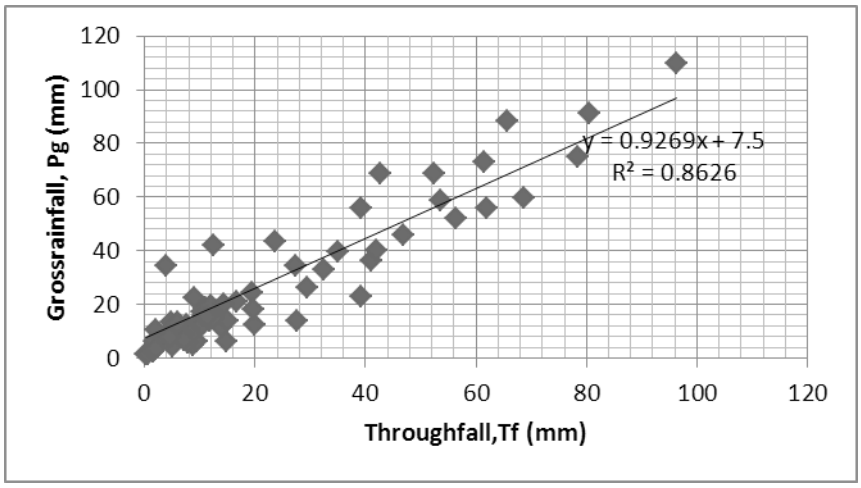

Figure 4: Linear regression of gross rainfall against throughfall to predict the throughfall coefficient for Plot11.

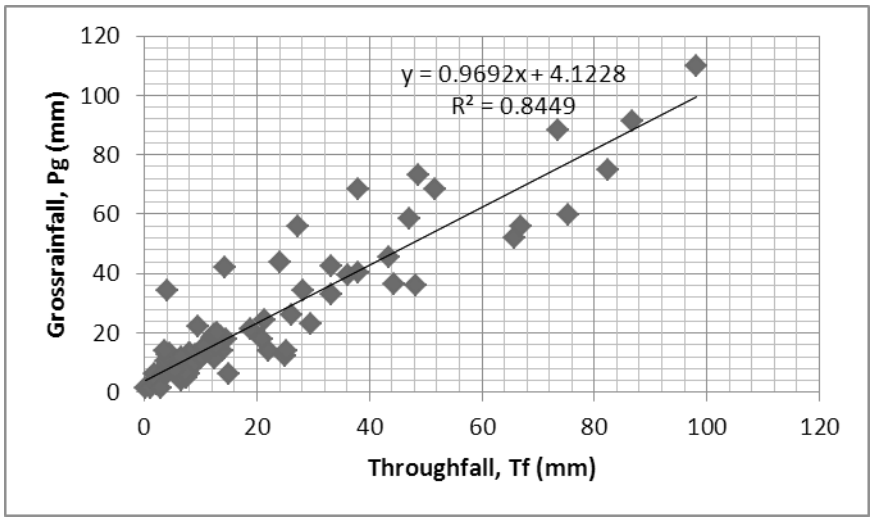

Figure 5: Linear regression of gross rainfall against throughfall to predict the throughfall coefficient for Plot12.

Canopy Storage Capacity, *S*

Canopy storage capacity obtained from linear regression of throughfall and gross rainfall. The negative interception of the regression shows the value of canopy storage capacity, *S*. In this study, the canopy storage capacity for Plot11 is 0.4981 and 0.2720 for Plot12.

The canopy storage capacity can be presented by Equations 4 and 5:

$$T_f = 0.863P_g - 0.498 T_f = 0.863P_g - 0.498 \text{ For plot11 } (r^2 = 0.876) r^2 = 0.876) \quad (4)$$

$$T_f = 0.8718P_g - 0.272 T_f = 0.8718P_g - 0.272 \text{ For plot12 } (r^2 = 0.845) r^2 = 0.845) \quad (5)$$

Stemflow

The total stemflow recorded for both plots is 0.255 (0.013%) for plot11 and 0.695 (0.032%) of the total gross rainfall within the study period. Based on the monthly stemflow as shown in the **Figure 8** highest stemflow recorded are 0.059 for the Plot11 and 0.133 for Plot12 respectively.

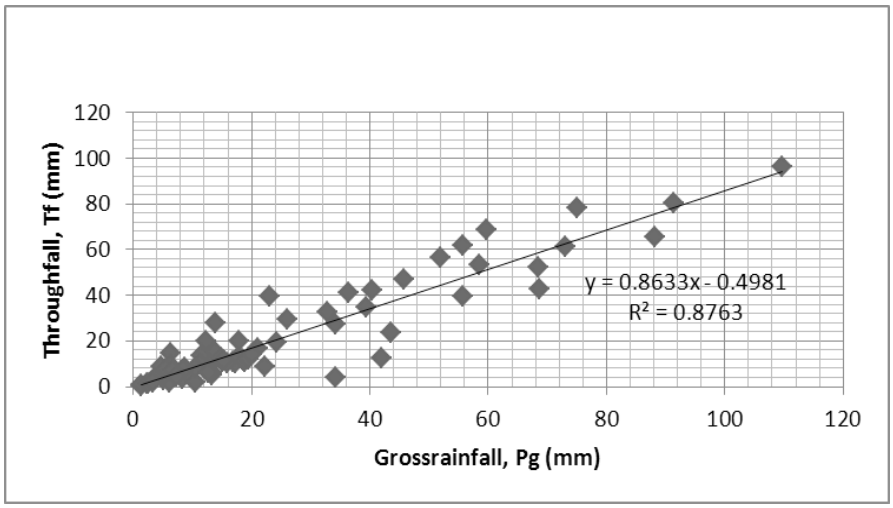

Figure 6: Linear regression of throughfall against gross rainfall to predict the canopy storage coefficient for Plot1.

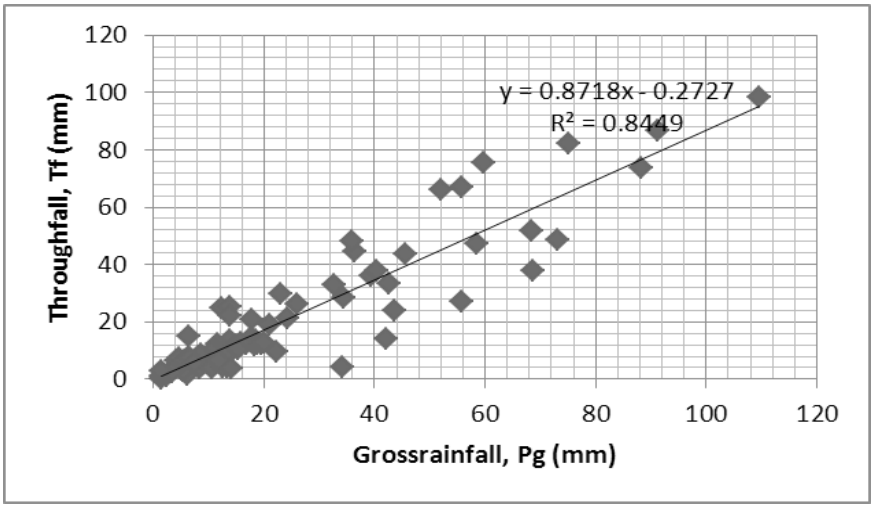

Figure 7: Linear regression of throughfall against gross rainfall to predict the canopy storage coefficient for Plot12.

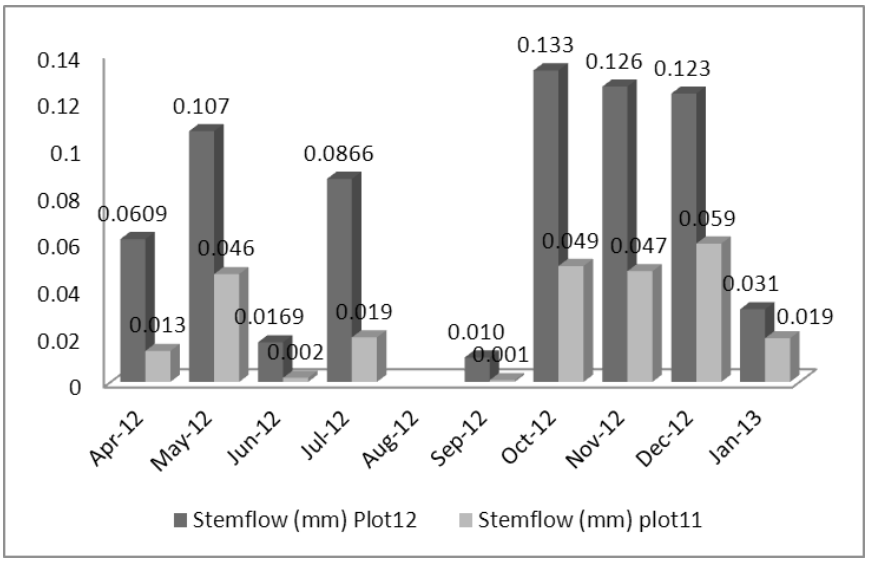

Figure 8: Monthly stemflow bar chart of Plot11 and Plot12

In this study the value of canopy storage capacity coefficient and trunk storage capacity coefficient for Plot11 are, $s_t s_t$ is 0.0014 and, $p_t\ p_t$ is 0.002 as the negative intercept on stemflow axis and the gradient of the linear regression between stemflow against gross rainfall with $r^2\ r^2$ value is 0.746, whereas in Plot12 the value of canopy storage capacity coefficient, $s_t s_t$ and trunk storage capacity coefficient, $p_t\ p_t$ were 0.003 and 0.0025 respectively and $r^2 r^2$ value is -0.0012.

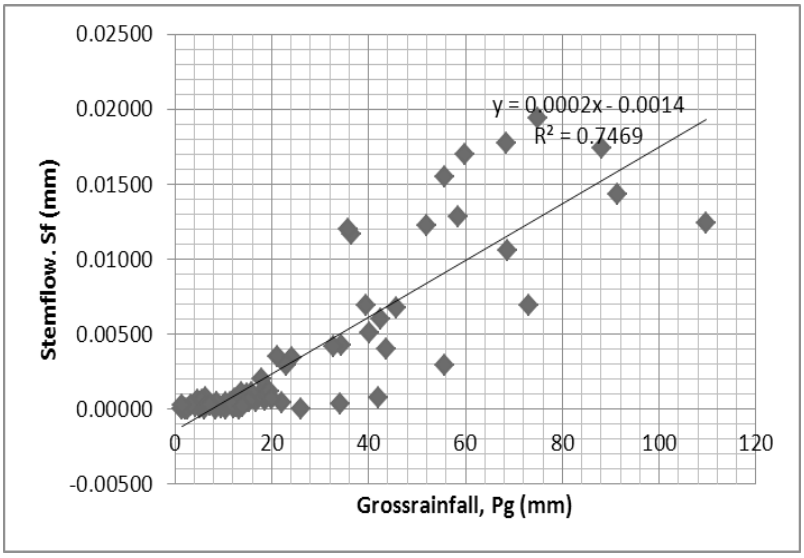

Figure 9: Linear regression of stemflow against gross rainfall to predict the canopy storage coefficient, $s_t s_t$ and trunk storage coefficient, $p_t p_t$ for Plot11.

Interception Loss, *I*

Interception losses values are determined in two different ways. It was determined from the measured data and calculated by applying Gash model. The measured interception loss obtained from the direct measurement for both Plot11 and Plot12 was 305.8 mm or 15.8% and 269.11 mm or 13.5% of the total gross rainfall.

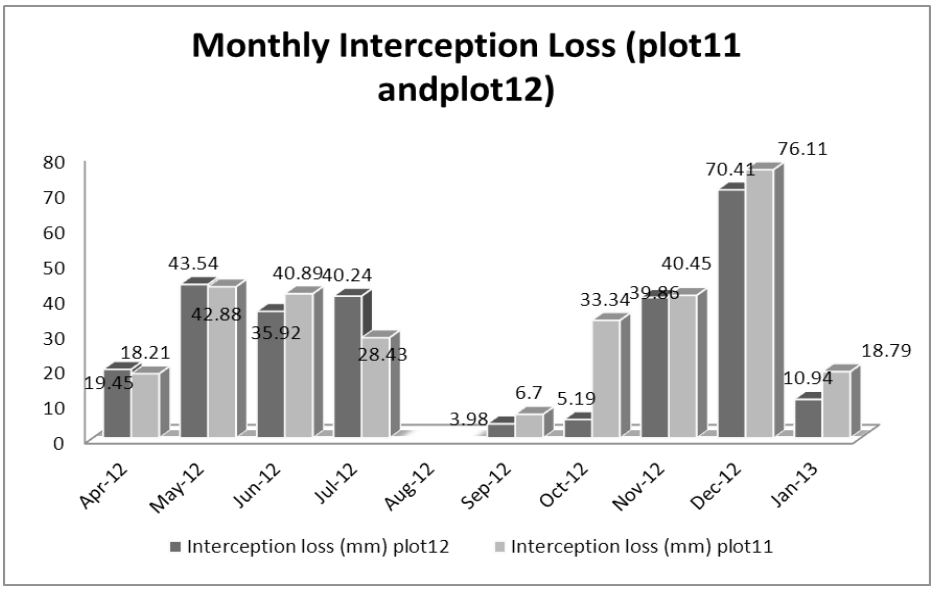

Figure 10: Monthly interception losses within the study periods for Plot11 and Plot12.

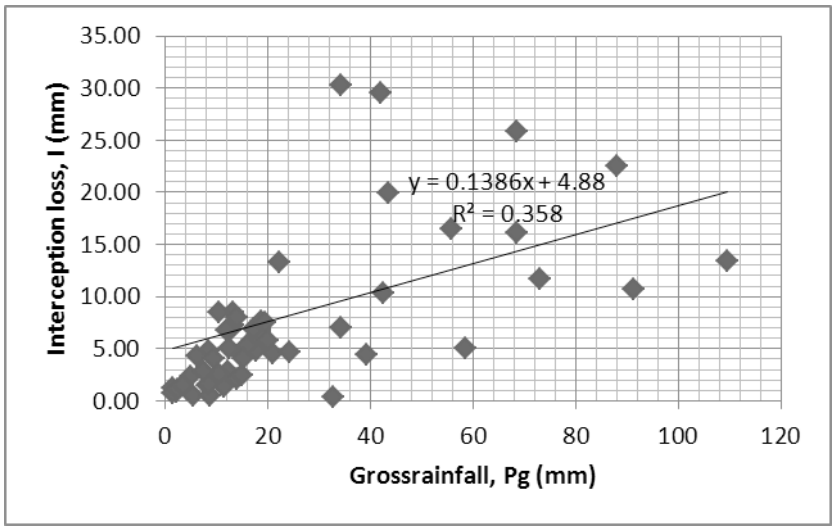

Figure 11: Regression of interception loss against gross rainfall to predict the ratio of evaporation rate and mean rainfall (Plot11).

The value of interception loss ranging from - 16.27 mm to 30.59 mm for both plots. The negative interception value due to the value of throughfall is higher than the gross rainfall. It may occur due to overestimation of throughfall or underestimation of gross rainfall. The factors that contribute to this problem is when the throughfall collector placed under the tree with relatively have a large leaves.

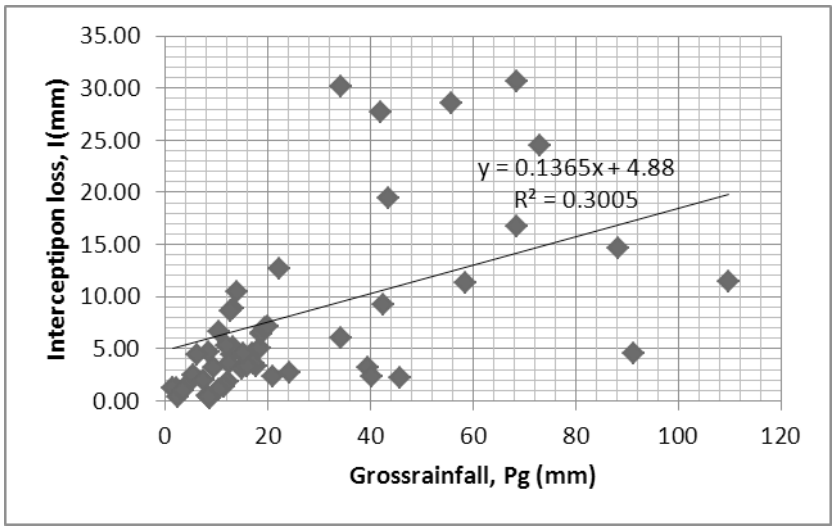

Figure 11: Regression of interception loss against gross rainfall to predict the ratio of evaporation rate and mean rainfall for Plot12.

The finding of this study was compared with the study other studies. The study that has been done at Air Hitam Forest Reserved, Selangor shows that the interception loss determine was 26.9 % (Nik *et al.*,1979). In the other study, it is estimated 18% interception loss of rainforest near the Kuala Belalong Field Studies Centre in Brunei (Dykes, 1997). It shows that the interception loss in this study also closer to the others study in which conducted at tropical rainforest as well.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the results that obtained from study, the following conclusion has been made.

1. Artificial tropical forest in Bukit Langong poses high dense of canopy cover structure that produce high interception loss and influence the natural hydrological cycle in the forest.
2. The calculated study the interception loss of Bukit Lagong Reserved Forest is 364.27 mm for the Plot11 and 318.07 mm for the Plot12, meanwhile the measured interception loss of Plot11 and Plot12 is 305.8 mm and 269.11 mm respectively.
3. The result of calculated Gash model and measured interception loss were compared as to meet the objective of this study. The results indicated that the Gash model produce higher value than the measured value. The results were compared in percentage form in which the Plot11 poses 19.1% and 18.2% as for the Plot12 compared to the measured value.

RECOMMENDATION

There are some recommendations made for this study:

1. For the improvement of data analysis, the period of data collection must be extending to get the better results of Gash model parameter analysis. In others study, they spent five years study in this related field.
2. To improve this study on the determination of Gash model parameters, the study of Leaf Area Index (LAI) must be consider obtaining the details result on the stemflow and throughfall analysis. The Leaf Area Index may be difference based on the trees species so that it may contribute different value of data collection. It also has a significant correlation between the canopy cover structures. As the Leaf Area Index increased the canopy cover structure also increased and it will give the significant results on the interception loss.
3. Seasonal changes should be consider in this study because in tropical rainforest there will be a month which the rainfall distribution is higher. Basically, October until January will be the wet season whereas July until September is dried season. These situations also influence the rainfall distribution which effects the data collection.

ACKNOWLEDGEMENTS

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Azinoor Azida Abu Bakar
Senior Lecturer, Fac. of Civil Eng.,
Uni. Teknologi MARA, 40450 Shah Alam, Selangor.

Muhammad Khairudin Khalil
Senior Asst. Director, Dept. of Irrigation & Drainage,
Jln Sultan Sallahuddin, Kuala Lumpur.

Siti Aishah Shamsudin
Researcher, Forest Research Institute of Malaysia,
Kepong, Selangor.

Jesuah Jimmy
Under-graduate Student, Fac. of Civil Eng.,
Uni. Teknologi MARA, 40450 Shah Alam, Selangor.

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Study on Wheeled Mobile Robot Performance in Multi Features Line Following Track

Elmi Abu Bakar, Ang Ooi Lun, Cheah Poh Soon, Chee Chang Fei, Chong Ching Yee & Chong Zheng Ziao

ABSTRACT

In robotic world, it is imperative to invent a mobile robot. Mobile robot also known as autonomous robot because of its autonomy characteristics. Hence, in this project, a wheel mobile robot, MC40A was programmed to move on the path that required by user as a very basic application of a mobile robot. MC40A is a line following wheel mobile robot. Five sensors were used to enable the direction of motion of this mobile robot. These sensors detect the black and white surfaces. The differences in the wheel speed enable right and left turning. This robot can be used in many industrial applications such as in automatic conveyor movement, cans labeling and others as well which can use the concept of black and white detecting concept. These pages provide the reader with the design and development of making the wheeled mobile robot to follow the line in black. By editing and programming the robot, it is able to complete the black line route given. This robot can be used to transfer objects from a position to the destination guided with black line. It can turn on sharp corners, turn 90° arc circle, walking through a loop, passing different width line and discontinuity line.

Keywords: Wheeled mobile robot, different width line, discontinuity line, programming

OBJECTIVE

To assembly the wheeled mobile robot (WMR) components and program the operation mode in order to move the wheeled mobile robot in different direction according to the black lines on the game field. At the end of this project, we have to compile the code and understand how the program runs. Besides that, we are able to explain each operation mode and have a basic understanding on how to program and operate the WMR according to mode task.

INTRODUCTION

Text The robot that we are using in our project is Educational Mobile Robot 2.0 (EDUBOT2) as shown in the figure below.

The robot is basically made up of:

i. A complete set of MC40A bundle with Aluminum base
ii. SPG10-15K Micro Metal Gearmotor Wheel
iii. LSS05 Auto-Calibrate Line Sensor

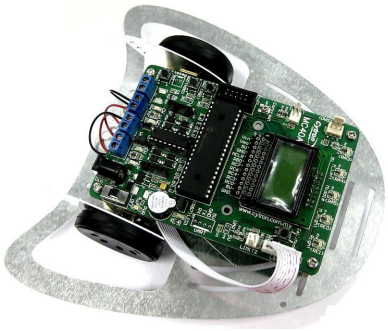


Fig. 1: Mobile Robot

This Educational Mobile Robot 2.0 is used to become an education mobile robot. It is ready assembled as shown in the photo. Its dimension is approximately 18.8cm X 18.2cm X 4.5cm.

Features of the robot:

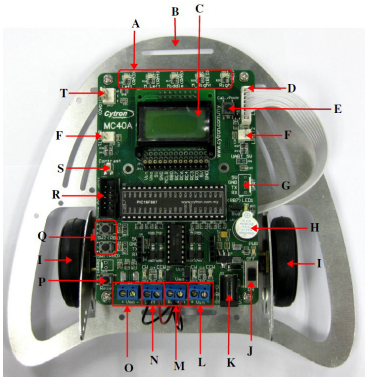


Fig. 2: Labels of the robot

The basic function of EDUBOT2 is line following robot. This robot may detect dark or bright line depends on setting at LSS05.

i. Press once - to enter the calibration mode.
ii. Press twice - to set the line sensor bar into **dark** line following mode.
iii. Press 3 times - to set the line sensor bar into **bright** line mode.

This button only applies if LSS05 is used. The additional specification of the product should be referred. According to the user manual, the operation voltage of the board is in the range of 6V to 14V. Motor supply voltage is between 5V to 12V. Maximum input current for the 5V circuit board is 500mA. Lastly, the maximum output current for the motor, per channel is 800mA.

There are 2 terminals may use to supply power to EDUBOT2. The source will supply power to on board microcontroller, LCD, analogue sensor and other components. It also may supply power to motor if Vin is select. The first terminal for power input is DC adapter input. User may use the standard AC to DC adapter to supply the power into EDUBOT2 through this terminal. The voltage should be between DC 7V-12V, typical value is DC12V.

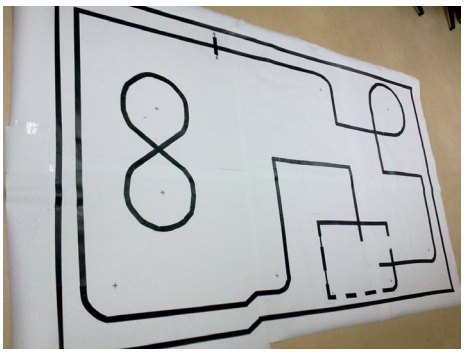
A robot is a machine which consists of hardware and software components. Programming is a way to give the robot the instructions or commands to do the task that we required. A robot needs both hardware and software components to function. The software we are using for this project is the C programming.

Table 1: Function of parts in robot

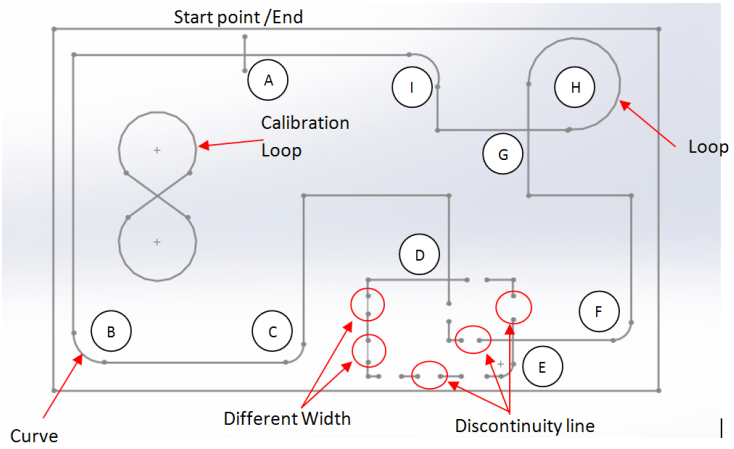
Parts	Function
A - Status indicator LED	The LED will turn ON when detect bright line in bright mode and detect dark line in the dark mode.
B - Aluminium Robot Chassis	This aluminium is for robot base.
C - 2x8 LCD Display	The LCD display is for displaying messages for the robot.
D - LSS05 connector	The connector is to connect sensor at the bottom of robot to board.
E - Cal/mode button	Calibration button used to enter mode for the robot.
F - LIMIT1/LIMIT2 port	Connector for adding limit switch.
G - UART	It is reserved for UART communication. Pin to pin is compatible with UC00A.
H - Buzzer	Buzzer as an output device.
I- Mini Wheel	Mini wheel which is mount with DC brush motor.
J- Main power switch	Power switch to switch ON or OFF.
K - DC adaptor socket	DC power adaptor socket for us to plug in power source. The input voltage should be range from 7 to 12V. Typical is 12V
L - Vin terminal block	Terminal block for Vin power supply. Besides use DC adaptor socket, we may use this terminal block to supply power. Only 1 connector should be connected to power
M - Right motor terminal block	Terminal block to connect right DC motor.
N - Left motor terminal block	Terminal block to connect left DC motor.
O - Vmotor terminal block	Terminal block to supply alternative power to DC motor. If we choose Vmo at JP5, we need to connect power to this terminal block.
P - Reset button	Reset button.
Q - Programmable push button	2 programmable push buttons
R - ICSP Programmer socket	2x5 box header for ICSP PIC programmer.
S - Contrast for LCD	5K of trimmer to set LCD contrast.

GAME FIELD

The actual game field is as below.



The schematic diagram of game field is shown below.



The characteristics of the labels are explained in the table below.

Table 2: Characteristics of the labels

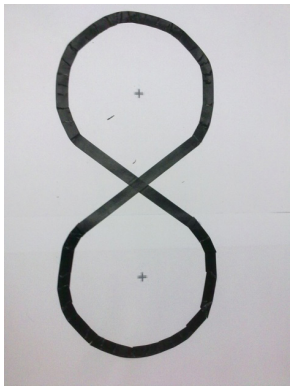
Label	Characteristics
A	Starting point
B	Big curve
C	Small curve
D	Junction 1
E	Junction 2
F	Small curve
G	Junction 3
H	Loop
I	Big curve

For Group P1, starting point given is point B. The robot will first follow the quarter circle at area B. It will walk straight until it reaches a sharp corner at the top left of the game field and then turn right. It will then pass area A that has a crossroad junction. It will continue walk straight and follow the right angle arc at area I and reach a right angle corner. It will then turn left to pass crossroad junction at area G. The robot will then enter the loop path in area H. After the robot followed the 270° circle loop, it will proceed to pass the crossroad in area G. For the incoming 2 sharp corners, it will first turn left and then turn right. The robot will then pass area F that has a right angle arc. It will then reach a crossroad junction in area E.

To reach junction in area D from area E, the robot has to travel through discontinuity line and different width line. After passing discontinuity line, different width line and short sharp corners, the robot will turn left at crossroad junction in area D. It will then turn left in the coming two sharp corners. After that, it will pass an arc in area C to right. The journey ends at area B.

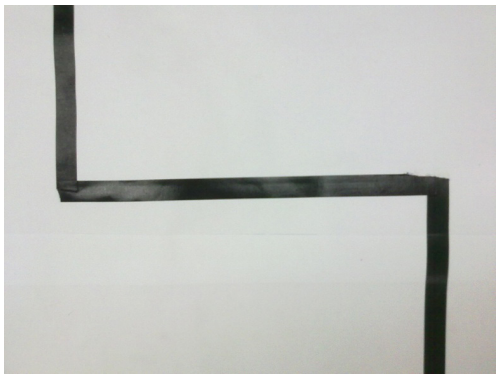
CRITICAL AREA

Calibration loop



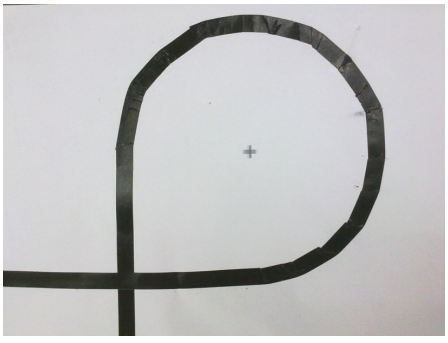
This loop will test the robot whether the sensors are in good condition and the programming is correct. If the robot manages to follow the entire black line, it means the sensors and programming are well calibrated.

Sharp corner



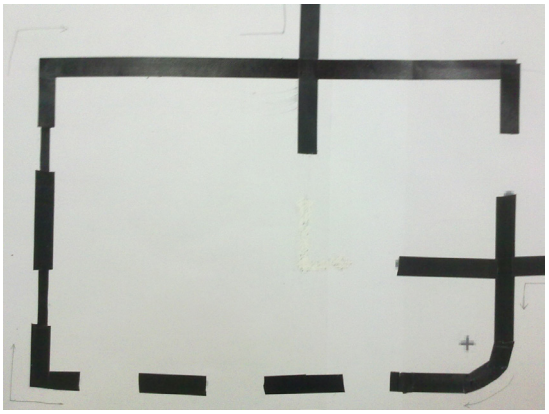
Challenge in this area is the robot has to turn 90° to left or right. Here is an example. The robot is walking straight by sensing black line at the 2nd, 3rd and 4th sensor. When there is black line extended to left (the robot has to turn left), the 1st sensor will sense the black line on the left. The speed of the left wheel is reduced so that the robot will turn left. The moving speed of the robot has to be controlled so that it will not pass the left black line before the sensor can sense it.

Loop



The robot comes in from left, makes a 270° circle and moves straight to bottom. From left, all 5 sensors of the robot will sense black. The robot will count the number of junction so that it will decide whether it is going to turn left, right or go straight. For this loop, the robot will move straight when passes the crossroad junction twice (once entering the loop and once leaving the loop).

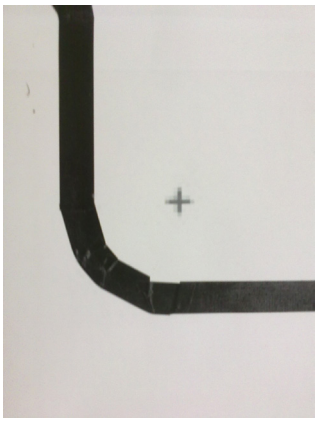
Discontinuity and different width line



For normal thick black line, the width will trigger 3 sensors in the robot. When the robot reaches thin black line, the line can be only detected by 2 sensors. Thus, the robot is programmed to move right or left when there are only 2 sensors detect black line. The robot will move a bit unstable at that area.

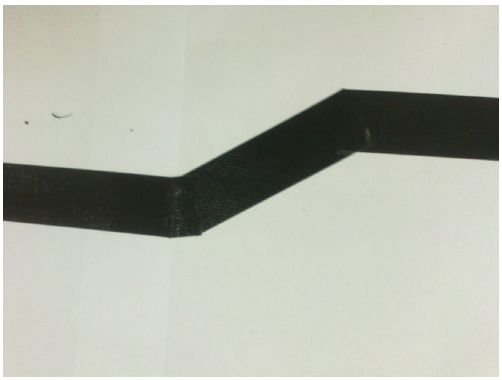
The robot will travel through discontinuity line before passing different width line. When all 5 sensors do not sense black line, it will recall back the previous movement. In this area, the previous movement is walking straight. Therefore, when the robot reaches blank area, it will walk straight to find black line.

3.1.5 90° arc



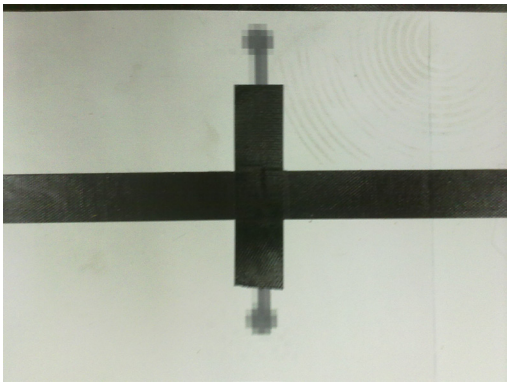
The sensors will detect the black lines and move according to the program configuration. For example, when it sense black line on left sensors, left wheel will rotate slower so that the robot can turn to left.

Slanting line



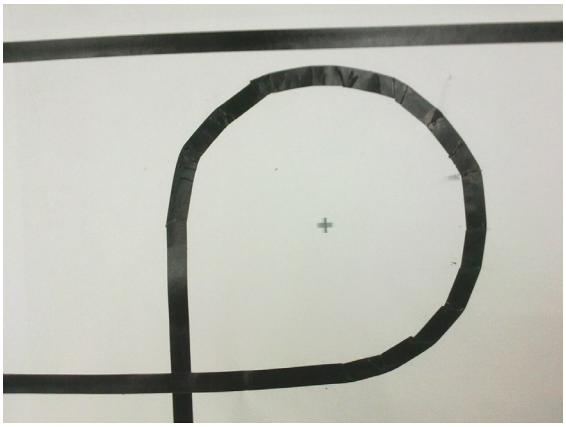
The sensors will detect the black line and the robot will move according to program. The robot will follow the direction detected by the sensor.

Crossroad junction



The sensors will detect 5 black signals when the robot passes through the crossroad junction. The program is specially written to count the number of junction passed. The number of junction will be counted starting from area B where the robot starts its route. For example, at the 4th and 5th junction, the robot will turn left.

Route and frame



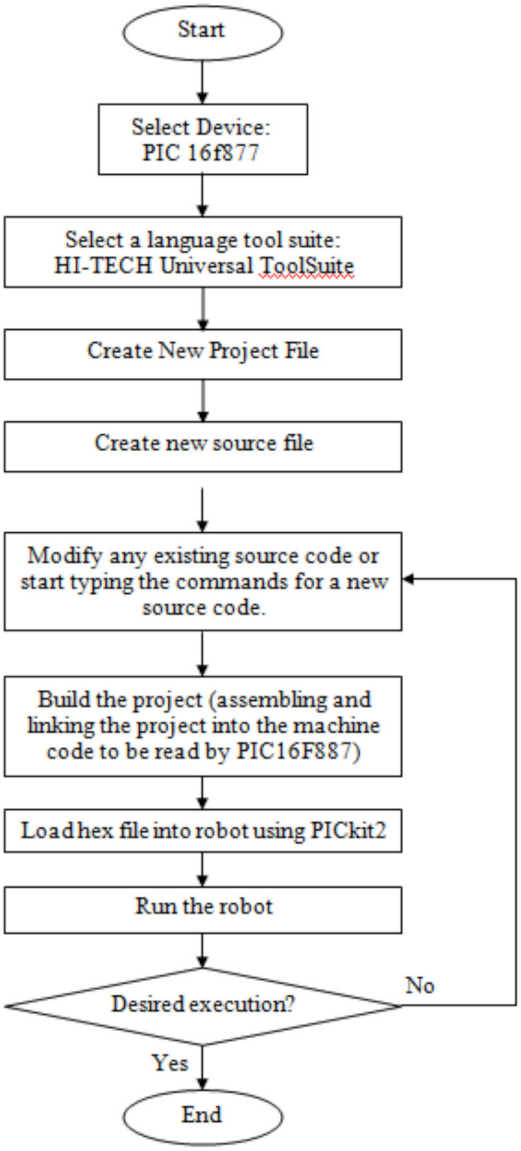
The sensors might detect the game field frame. To solve this confusion, special code is created to delay the movement of the robot. The robot will turn right a bit so that it stays inside the frame and will detect back the black line route.

PROGRAMMING

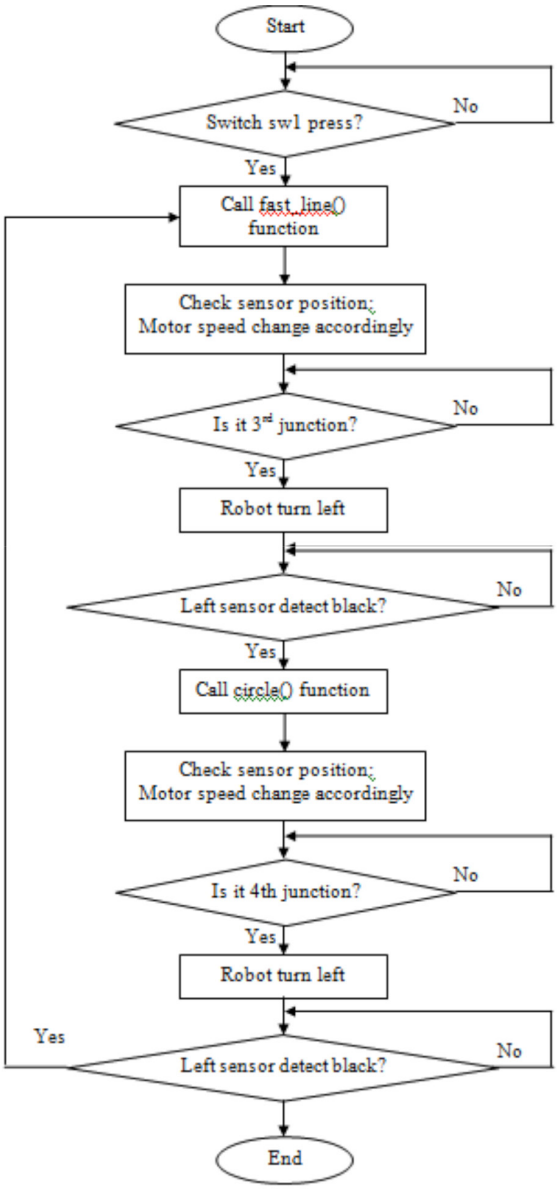
Program is written to control the robot so that it will follow the black line and complete the route. Complete code is attached behind.

FLOW CHART

The flow chart below shows the basic steps to create and execute a project:



Programming flow chart:



DISCUSSIONS

In this project, there are 2 terminals use to supply power to the robot. One of the terminal supply power to the circuit board, microcontroller, and the sensors. The second terminal supplies the power to the motor. The first terminal is connected with a 9V heavy duty battery to power the board. The second terminal is connected to a Li-polymer battery to power the motor in order to turn the wheel for moving the robot.

During the programming, the robot is set to run by following the colours of the line. We only apply the line following mode in our robot. In our case, the game field only include white and black colour. Therefore, the programming will be adjusted accordingly for the robot to run based on the black line. The speed of the motor will be adjusted for particular condition. For example, we will slow down the turning rate of the left wheel when we want the robot to turn left and vice versa.

The sensor used for detecting the track is IR sensor. There is a total number of 5 sensors, all located under the front part of the robot. It consists of emitter and receiver. Before running the robot, we have to calibrate the robot to enable the robot to recognize and differentiate the intensity of the black colour line and the white colour background. It is preferable to place the on a grey colour surface. By default setting, when a black line is present under the IR sensor, a signal 1 to the PIC, when a white surface is present, signal 0 will be sent to the PIC.

In order to make sure the robot will be able to run in track, we have taken in considerations of few conditions. As the curves, junctions and width of the black lines is non-uniform, the sensors might not be able to sense the black lines all the time. Following are the line sensing condition and motor reaction. We have grouped and reduced the conditions into 17 conditions in order to avoid redundant conditions.

Symbol	Indicate
1	The sensor sense black line
0	The sensor send the white background

No.	S1	S2	S3	S4	S5	Motor Reaction
1	1	0	0	0	0	Slow down the turning rate of the left wheel.
2	1	1	0	0	0	
3	1	1	1	0	0	
4	1	1	1	1	0	
5	0	1	1	1	1	Slow down the turning rate of the right wheel.
6	0	0	1	1	1	
7	0	0	0	1	1	
8	0	0	0	0	1	
9	0	1	1	1	0	Both wheel rotating at the same rate.
10	0	1	1	0	0	Slightly slow down the turning rate of the left wheel.
11	0	0	1	1	0	Slightly slow down the turning rate of the right wheel.
12	1	0	0	0	1	500ms delay.
13	1	0	0	1	1	
14	1	0	1	1	1	
15	1	1	0	0	1	
16	0	0	0	0	0	Recall the previous K value.
17	1	1	1	1	1	Counting the number of junction.

For condition 1 to 4, when the sensors detected the black line is located at the left, it will automatically make a correction by slowing down the speed of the left wheel. As the right wheel turns faster, the robot tends to turn left. This ensures that the robot is always moving on the track. The same theory applies to the fifth to eight conditions using the opposite direction.

When the sensors sense the black line is located directly under the robot as in condition 9, it will continue moving straight. However for condition 12 to 15, the robot tends to delay for 500ms. After that, it will continue moving with the command as '1 0 0 0 0', which is slowing down the turning of the left wheel.

Condition 16 is used when the robot is moving on a blank surface without the guidance of any black line. This condition can applies when the robot is moving along the dotted line. In this situation, the robot will refer to the previous 'K' value to determine the next step. For example, if the robot is moving in a straight line before entering the blank region, it will recall that particular command and continue moving forward.

When condition 17 occurs, it means that the robot has come to a junction. In this situation, the robot is given the job to count the number of junction. A specific task is given to the robot at every particular junction. In this project, the robot is given the command to move straight forward or turn left/right.

The maximum speed for the motor is 255, but our robot is set to move at lower speed so that we can identify the motion of the robot and it has enough time to sense the black line and react upon condition. Overshoot may always occur at higher speed. The phenomenon can be explained by the road accident that always occurs due to high speed and insufficient time to react upon condition.

CONCLUSIONS

The movable structure of a wheeled mobile robot is under some autonomous control. In this project, the robot is control under the C programming and the colours of the surface the robot is moving.

By changing the speed of the two wheels of the wheeled mobile robot according to different condition, we are able to control the path we want to take. If both the wheels are driven in the same direction and speed, the robot will go in a straight line. Otherwise, the motion is depending on the speed of rotation and its direction. Since the direction of the robot is dependent on the rate and direction of rotation of the two driven wheels, these quantities should be sensed and controlled precisely.

In a nut shell, this project provides us a better understanding about the wheel robot since there are applications of mobile robots. It also gives us the chance to involve in more hands-on experience on real mechanical system study.

Elmi Abu Bakar
School of Aerospace Engineering, Universiti Sains Malaysia
Email: meelmi@eng.usm.my

Ang Ooi Lun
Cheah Poh Soon
Chee Chang Fei
Chong Ching Yee
Chong Zheng Ziao
School of Mechanical Engineering, Universiti Sains Malaysia

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A Review of Resonant Converter Control Techniques and The Performances

T. A. Izzuddin, M. H. Jali & H. Sarkawi

ABSTRACT

This paper presents different control techniques and the experimental results for resonant converter. The paper first discusses each control technique and then gives experimental results and/or performance to highlights their merits. The resonant converter used as a case study is not specified to just single topology instead it used few topologies such as series-parallel resonant converter (SPRC), LCC resonant converter and parallel resonant converter (PRC). On the other hand, the control techniques presented in this paper are self-sustained phase shift modulation (SSPSM) control, self-oscillating power factor control, magnetic control and the H-∞ robust control technique.

Keywords : Resonant converter, control technique, experiment results, topologies

ABSTRAK

Kertas kerja ini membentangkan teknik-teknik kawalan dan keputusan eksperimen bagi penukar salunan. Pertamanya, setiap teknik kawalan dibincangkan dan kemudian keputusan eksperimen dan prestasi setiap teknik dipaparkan untuk mengetengahkan merit mereka. yang digunakan Bukan hanya penukar salunan topologi tunggal sahaja dibincangkan, malahan beberapa topologi lain seperti penukar siri-selari salunan (SPRC), LCC penukar salunan dan penukar salunan selari (PRC). Beberapa kawalan akan dibentangkan seperti fasa diri berterusan peralihan modulasi (SSPSM) kawalan, kuasa diri berayun faktor kawalan, kawalan magnet, dinamik nadi modulasi (TPM) dan H-∞ kawalan yang mantap teknik.

Kata kunci : Penukar salunan, teknik kawalan, keputusan eksperimen, topologi

INTRODUCTION

In the early years, the common control technique for power conversion is based on pulse width modulation (PWM) control method. However the PWM converters operate under high current levels that cause high switching losses. Thus the operation frequency has to be limit to reduce the losses.

Resonant converter has superiority compare to PWM converters in term of switching losses reduction, high switching frequencies and lower harmonic content. This is due to capacitor voltage and current waveforms of the resonant converter exhibit sinusoidal behaviour that enable it to operate in high switching frequency [10]. This also leads to faster transient response and smaller magnetic component.

Resonant converters has been widely used in the power electronics application such as powers supply, induction heating and electronic ballasts. It is because of the industrial need to the smaller and lighter weight of high performance converters. The performance of the resonant converter is highly depend on the control technique. The controller technique is quite complicated due to dynamic characteristics of the converter to the changes in the input voltage or load[3].

DIFFERENT CONTROL TECHNIQUES FOR RESONANT CONVERTERS AND THE RESULTS

Several control technique will be presented in the paper such as self-sustained phase shift modulated technique that is a combination of self-sustained oscillation mode and phase shift modulation technique to achieved zero voltage switching within lower frequency variation. Self-oscillating power factor control work by varying the power factor between the fundamental of the input voltage and current. Magnetic control regulate the dc output voltage by changing the value of the resonant inductance where certain part of the magnetic core operates closed to saturation region. Dynamic pulse modulation technique kept output voltage ripples to a minimum by controlling the pulses in the integral number depending on the load side requirement. H-∞ robust control is implemented based on structured uncertainties of the system.

Self-sustained phase shift modulation control

Self-sustained phase shift modulation (SSPSM) controller exhibit the functionality of self-sustained oscillation mode(SSOM) controller that can regulate the output voltage and zero voltage switching (ZVS) at the same time [1], [2] and phase shift modulation (PSM) controller that capable to achieve ZVS at the constant frequency[3] in a single controller. It has less complex construction than hybrid controller and offers a good ZVS capability within lower frequency variation [4].

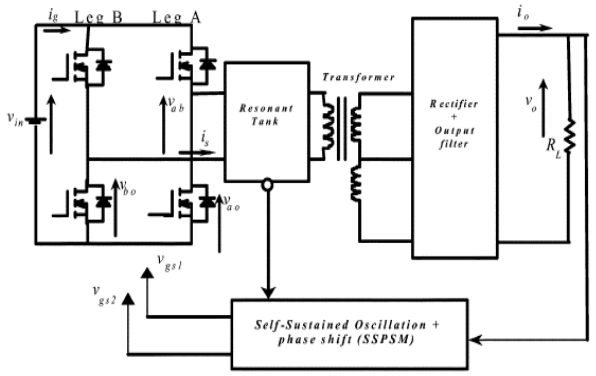

Fig. 1: Series-parallel resonant converter with SSPSM controller

There are two distinguish control angles in SSPSM which are γ_{1a} and γ_{1b}. γ_{1a} is the phase angle between the voltage across the bottom switch of one leg of the full bridge converter (V_{ao}) and the resonant tank current(i_s). γ_{1b} is the phase angle between the voltage across the bottom switch of the other leg of full bridge converter (V_{bo}) and the i_s (Fig. 1). The converter will operates in SSPSM mode by keeping γ_{1a} constant while γ_{1b} act as a control variable [4].

The resonant current must lag the output voltage of the inverter and also must met the zero crossing inside pulse-width modulation (PWM) pulse to achieve the ZVS. Refer Fig. 2, the conduction of both legs A and B is measured from the resonant current zero crossing instant and the voltage produce by leg A leads the voltage produce by leg B. Thus V_{ao} become the leading edge of the positive and negative PWM pulse. Therefore leg A actually ensured the current zero crossing inside PWM pulse. In the meantime, leg B becomes the trailing edge of the positive and negative PWM pulse. Thus, leg A actually control the switching frequency and leg B control the PWM pulse width [1].

In short, to ensure both voltages regulation output and the ZVS perform concurrently; the SSPSM has to control the switching frequency and the PWM pulse simultaneously. Therefore SSPSM controller is build in two loops which are inner loop and outer loop (Fig. 3). The inner control loop function is to assure the resonant current (i_s) lags the inverter output voltage (V_{ab}) that guarantee ZVS to be happen by adjusting the phase shift between i_s and inverter legs voltage V_{ao} and V_{bo}. Whereas the outer loop function is to adjust the output voltage (V_o) according to reference value [2].

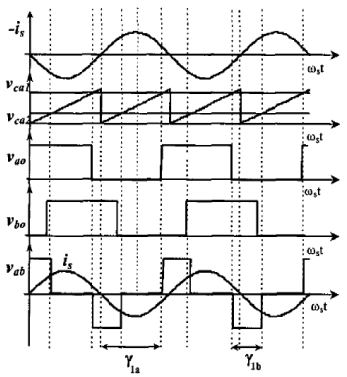

Fig. 2: Main converter waveforms of SSPSM

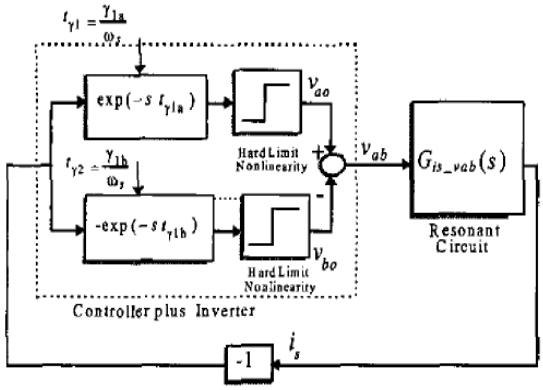

Fig. 3: Block diagram and operating waveforms

Performance and experimental result

In order to illustrate the performance of SSPSM controller, series parallel resonant converter with a capacitive output filter is used as a case study [4]. The selection is based on the behaviour of the topology that have low voltage and high current output [5]. The circuit diagram is shown in Fig. 1. The performance also is compared with several other controllers.

Switching Frequency

Fig. 4 shows that SSPSM has lowest switching frequency range compare to others. This will reduce the magnetic losses that lead to compact converter size [4].

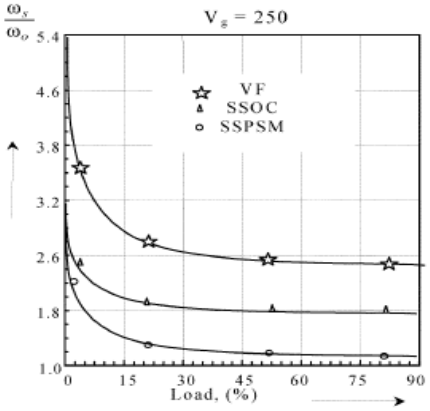

Fig. 4: Experimental result of switching frequency of VF, SSOC and SSPSM

Efficiency

Fig. 5 shows that the SSPSM control technique produce better efficiency than SSOC due to SSPSM has a narrower range of switching frequency [4].

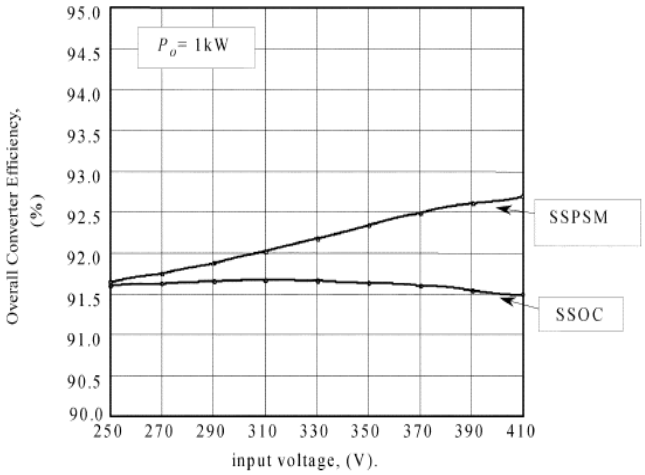

Fig. 5: Efficiency of SSPSM and SSOC

From the performance result, it can be concluded that SSPSM control technique works well with output capacitor filter to produce a good transient response. Besides that, it also has high ZVS capability which is the main objective of resonant converter. It also has better performance in term of switching frequency and efficiency compared to the other several control technique.

Self-oscillating power factor control

One of the main issues of resonant converter is highly non-linear dynamic characteristics that are normally associated with such systems. A control strategy is therefore needed that can approximately linearizes the behaviour of the. Although other technique is reported previously [6], [7] that aim to linearize the converter's behaviour, the mechanism presented is quite complicated. On the other hand, the used of power factor control technique has advantages over traditional

frequency control technique. In [8], it can be seen that self-oscillating control provides self-tuning relative to the resonant tank frequency, reduced controller sensitivity near resonance, and the ability to ensure switching at all times is either above resonance (for ZVS) or below resonance (for ZCS) depending on application requirements. To achieve linearize behaviour and by using self-oscillating control, a system is presented in [9], [10] and is reviewed in this paper.

The principle operation of self-oscillating control of LCC current-output resonant converter is by varying the power factor between the fundamental of the input voltage and current. Fig. 6 shows the LCC resonant converter circuit. This technique is convenient, linear system input-output characteristic suitable for the design of regulators compare to other commonly employed control methodologies [9]. It is also shown to have a similar effect as controlling the dc-link supply voltage, in terms of output-voltage/current control.

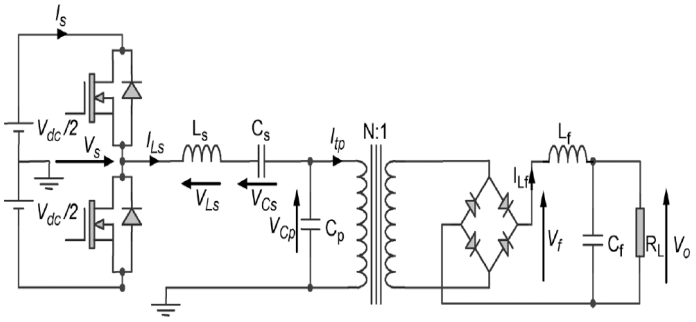

Fig. 6: LCC resonant converter circuit diagram

For output voltage control, the overall system can be shown in Fig. 7. As seen in the figure, PI controller is used for ensuring the stability of the system.

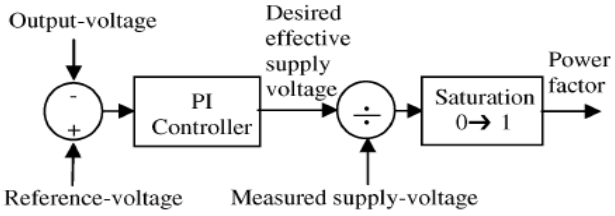

Fig. 7: Closed-loop output voltage regulation with power factor control block diagram

Experimental results

The experimental result of using power factor controller is shown in Fig.8. It can be seen clearly that the power factor control technique provides an almost linear control to output relationship.

It can be concluded that a power factor control strategy which provided for the LCC current-output resonant converter is advantageous in such a way that it linearizes the steady-state input-to-output conversion ratio.

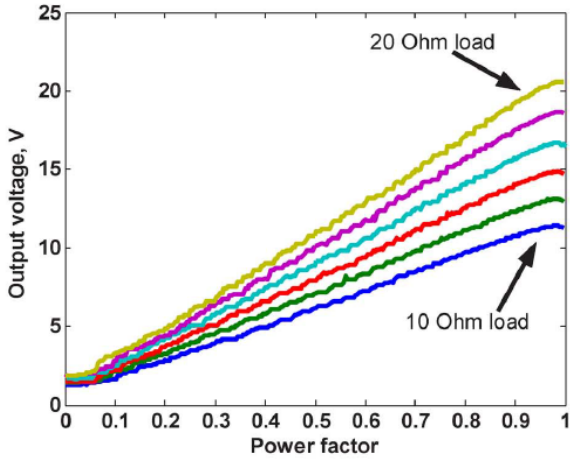

Fig. 8: Result of output voltage across various loads when using power factor control

Magnetic control

Fixed frequency control technique for dc-dc resonant converter allow the operation of converter at constant frequency which capable of ZVS. However, when the input voltage is wide and under light load conditions, it loses the ZVS capability [11]. On the other hand, the used of dc-dc resonant converter based on full-bridge topology with phase control requires extra power switches and control circuitry, thus increases the cost of the converter. To solve the problems mentioned above, an alternative for the fixed frequency operation is needed. Since magnetic regulators have appeared as a solution to achieve fixed frequency operation in other electronics applications [12], [13], their usefulness in dc-dc resonant conversion has been investigated in [14], [15], and is reviewed in this paper.

In paper [14], [15], a variable inductor in the resonant tank is used to achieve fixed frequency dc-dc resonant converter as shown in Fig. 12. As illustrates, the structure basically similar to any dc-dc resonant converter, only variable inductance instead of non-variable inductance makes it different.

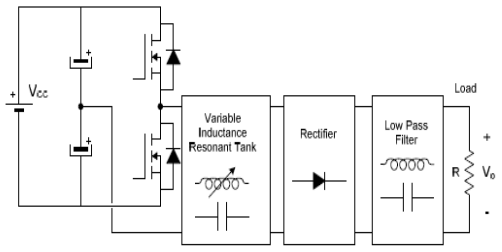

Fig. 9: Dc-dc resonant converter with variable inductance

The dc output voltage is regulated in such a way that by changing the value of the resonant inductance where certain part of the magnetic core operates closed to saturation region. By implementing dc current source from the output voltage of the converter, the inductance can be varied (controlled). Thus, by changing the value of the resonant inductance, the characteristic of the resonant tank can be modified and the output voltage can be regulated while maintaining fixed frequency operation. In general, there are many configurations of resonant converters. However,

the two most common resonant converters which magnetic control technique could be applied in principle is illustrates in Fig. 10. Fig. 10(a) shows the series resonant converter (SRC), which corresponds to a resonant tank in which is connected in series with the resonant elements. On the other hand, the parallel resonant converter (PRC) is shown in Fig.13(b).

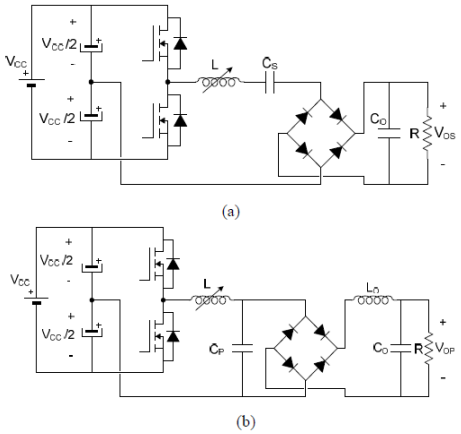

Fig. 10: Resonant converters with magnetic control:
(a)series resonant tank, (b)parallel resonant tank

The equivalent circuit of the dc-dc parallel resonant converter is shown in Fig. 11. For the input side, the square wave generated by the half-bridge is model by V_1. On the other hand, the effective resistance (R_e) is a model for the output load gathered from output of rectifier, lowpass filter and load resistance (R).

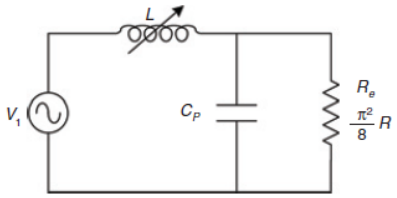

Fig. 11: Dc-dc parallel resonant converter equivalent circuit

Fig. 12 shows the dc output voltage characteristic of the resonant converter for a given case. As shown, it is possible to attain operation from full load to no load by varying the resonant inductance.

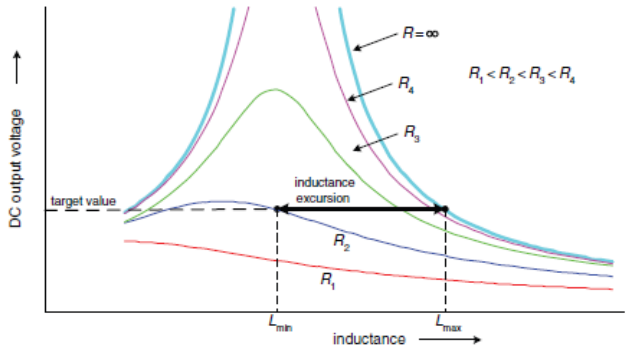

Fig. 12: Output voltage characteristics of parallel resonant converter with magnetic control

Prototype and experimental results

In [14], [15], an experimental prototype has been developed in order to test the possibilities of the dc-dc resonant converters with magnetic control. The prototype has specification as follows:Input voltage - 48 V, Output voltage - 5V,Maximum output current - 10A and Switching frequency - 500 kHz

A step-down transformer is used between the resonant capacitor and the output rectifier to achieve the necessary step-down ratio. The converter is operated in closed-loop by using an error amplifier and a voltage controlled current source. The complete electric diagram of the prototype can be seen in Fig. 13.

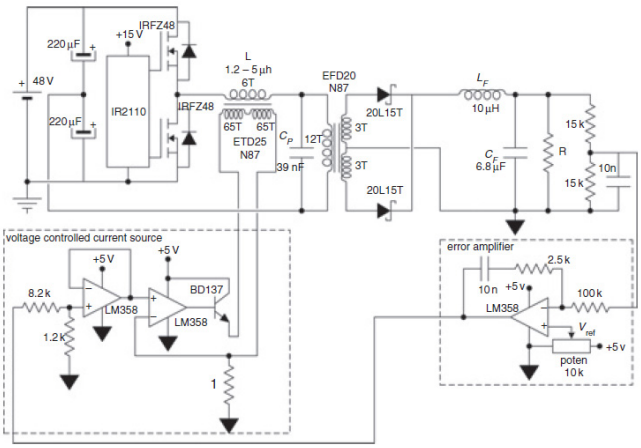

Fig. 13: Schematic circuit of complete prototype

The measured dc output voltage against the resonant inductance for open loop operation is shown in Fig. 14. It is clearly can be seen and verified that the output voltage is controllable through the inductance value while maintaining fixed frequency.

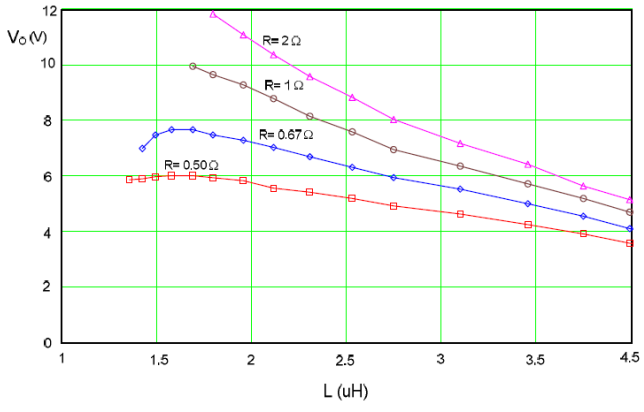

Fig. 14: Experimental results for open-loop operation: Measured dc output voltage as a function of the variable inductance for different loads

On the other hand, the closed-loop operation is done by varying the input voltage from 34V to 68V. The result is shown in Fig. 15. By referring to the figure, the output voltage is properly regulated is with a condition that there is margin for the dc control current to operate the converter. As can be seen, as long as the input voltage is increased, the converter decreases the inductance

control current, thus increasing the resonant inductance and ensuring constant output voltage. The limitation of the output voltage regulation occurs at higher voltage range where it is limited by the ZVS-ZCS boundary.

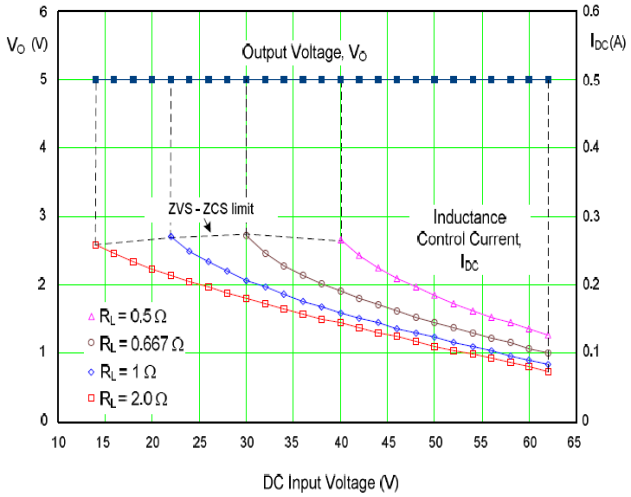

Fig. 15: Experimental results for closed-loop operation: Measured output voltage and inductance control current as a function of the dc input voltage

Overall, the use of the resonant inductance as a control parameter can provide output voltage regulation while ensuring fixed frequency operation thus reducing the size of the EMI filter, which otherwise would be high when using variable frequency control. Since the variable inductor does not suffer extra losses compared to a traditional non-variable inductor, the converter efficiency remains the same.

Control based on Robust H-∞ control approach

Authors in [25] proposed a robust controller design based on the H-∞ control paper. In this paper the authors argued that using conventional method such as the variable frequency (VF) [21-22] will result in non-optimized magnetic component design due to frequency variations while the phase shift modulation (PSM) method tend to lose zero-voltage at light loads due the deficiency in the leakage inductance energy [26].

Similar to paper proposed in [20], this paper tries to address the converter performance such as the voltage ripple, which is cause by structured and unstructured uncertainties in the converter. Implementation of robust control techniques can overcome this matter and isolate the converter from various kinds of uncertainties. Several robust control methods have been proposed, but these methods only deals with unstructured uncertainties which limit the control gain due to stability concerns [27].

In order to implement robust control technique, a system model is required. Several modeling method have been proposed such as sampled data-dynamical model [28], lumped parameter circuits model [29] and Extended Describing Function (EDF), however derivation using this methods will result in the order of the system's model to be too high and this is impractical for a controller design. To address this, the authors have proposed a system model based on the fundamental component of the full-bridge output voltage and the resonant inductor voltage,

while a H-∞ robust controller is implemented based on structured uncertainties of the system. Fig.16 shows the proposed closed loop controller.

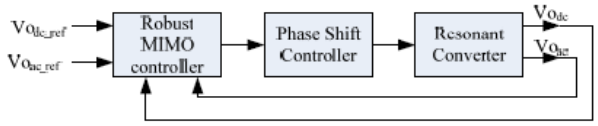

Fig.16: Proposed closed-loop controller [25]

Control principle

For the purposes of designing the H-∞ controller for the system, a model had to be derived based on the Linear Fractional Transformation approach. The proposed technique started by mathematical representation of the system using state-space model. (Details on LFT modeling procedures can be referred at [25], this review paper only concerns on controller principle of the proposed technique). This model is then transformed using the LFT, which assumed that parameters of the steady-state coefficients in the model are bounded in a certain interval. This transformed LFT model can then be represented in a block diagram depicted in Fig.17.

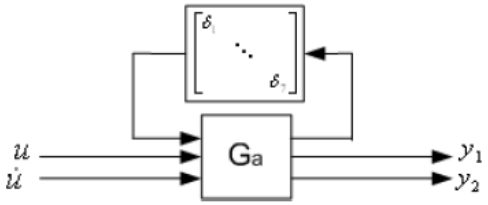

Fig.17: The LFT representation of the system

After the system is represented using LFT, the next step is to design the control objectives. In other words, we need the controller gain K in the control law $u(s) = Ky($ $u(s) = Ky($ that will guarantee robust and stability performance. Closed loop of the proposed control system is shown in Fig.18.

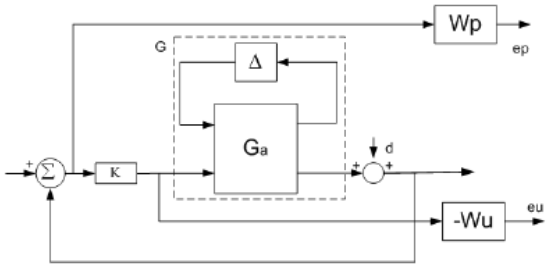

Fig. 18: The LFT representation of the system [25]

Wp and Wu shown in the figure are the weighting functions. These functions represent the frequency specifications of the external disturbances. The first step in finding the robust controller gain K, is to examined the nominal stability and performance requirements. In other words, the

chosen K should satisfy the performance requirements of the nominal system inside the closed-loop system. This can be achieved by determining K which satisfies the following conditions:

$$\left\| \begin{bmatrix} W_p S(G_a) \\ W_u KS(G_a) \end{bmatrix} \right\|_\infty < 1$$

The second step is to analyze the robust stability and performance. Robust stability implies that the closed loop system is stable for all possible plant models G=Fu(Ga,Δ).G is represented by the dashed rectangle shown in Fig.7. Δ here represents the unknown uncertainties ($\|\Delta\|_\infty <$ $\|\Delta\|_\infty <$. In order to achieve robust stability, controller gain K must satisfy the robust performance criteria below:

$$\left\| \begin{bmatrix} W_p (1 + GK)^{-1} \\ W_u K(1 + GK)^{-1} \end{bmatrix} \right\|_\infty < 1$$

One of the major hurdles in H-∞ control design is to determine weighting functions Wp and Wu. No explicit formula was used in determining the weighting functions, and usually weighting functions were determined using trial and error methods. However in the proposed method, weighting functions of the system is determined based on comprehensive studies done in [30]. The weighting functions are then selected as follows:

$$W_p(s) = 0.95\frac{s+1}{s+\epsilon} \qquad W_u = \frac{m}{U_o}$$

Here is chosen as a small number in order to satisfy the condition observability and detectability in H- optimize algorithm.

Experimentation result

To verify the feasibility of the proposed scheme, a 3 [kW], 120 [kHz] series-parallel resonant converter have been developed by the authors. The converter is tested in no-load and full-load conditions. The inductor current for both of these conditions is depicted in Fig.19. From the figure, we can clearly see that the waveforms are free from any spike, and therefore the authors confirmed that the soft-switching is guaranteed from no-load to full-load. Fig.20 shows the ripple from the output voltage. From the figure, the proposed method shows an excellent voltage regulation (ripple: 5 [V] in 25 [kV] regulation: 0.02%) when compared to a PI controller (ripple: 100 [V] in 25 [kV] regulation: 0.8%).

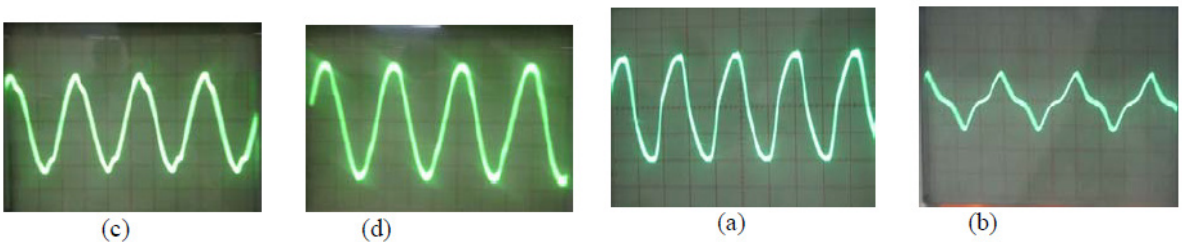

Fig.19: Resonant current at (a) no load (b) 60% of full load (c) 45% of full load (d) full load[25]

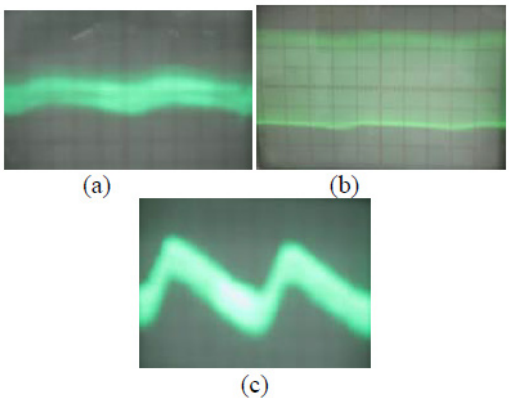

Fig.20: (a) and (b): output voltage by proposed controller. (c): output voltage with PI controller [25]

CONCLUSION

SSPSM control technique works well with output capacitor filter to produce a good transient response. Besides that, it also has high ZVS capability which is the main objective of resonant converter. It also has better performance in term of switching frequency and efficiency compared to the other several control technique. On the other hand, power factor control strategy which provided for the LCC current-output resonant converter is advantageous in such a way that it linearizes the steady-state input-to-output conversion ratio. The use of the variable inductance as a control parameter can provide output voltage regulation while ensuring fixed frequency operation thus reducing the size of the EMI filter, which otherwise would be high when using variable frequency control. Since the variable inductor does not suffer extra losses compared to a traditional non-variable inductor, the converter efficiency remains the same. This means that it is resistant to any changes in DC supply voltage and load resistance. Meanwhile the H-∞ Robust Control technique is a good technique to reduce the ripples in the output voltage and improves the dynamic performance of a resonant converter. The former provides us with a simple technique without having to increase the size of the output filter, while the latter provide us with a robust control to cope with uncertainties in the converter.

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T. A. Izzuddin, M. H. Jali & H. Sarkawi
Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal
Melaka, Malaysia
tarmizi@utem.edu.my(06-5552361)
mohd.hafiz@utem.edu.my(06-5552331)
hafez@utem.edu.my(06-5552112)

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Determining Wireless Local Area Network Vulnerabilities on Academic Network

Amran Ahmad, Ali Yusny Daud & Fazli Azzali

ABSTRACT

The advancement and proliferation of wireless local area network nowadays have driven for an alarm on the whole network operation. The concern applies to both business and academic computer network environments. This paper describes our research and experiences in performing network vulnerabilities analysis in academic local area network. The research uses network vulnerability analysis methodology to perform vulnerability analysis on Academic and Administration building. From the analysis, the overall network security level can be determined. Remedies and solution to counter any vulnerability can also be prescribed and this will reduce network vulnerability threat to academic local area network.

Keywords: WarDriving, network vulnerabilities, vulnerability analysis

INTRODUCTION

Wireless technology gives users the freedom of mobility, gives network designers more options for connectivity, and gives many new devices the capability to connect to network. However, wireless technology brings significantly more threats or vulnerability than traditional wired networks. The issue of network vulnerabilities of wireless Local Area Network (LAN) is very demanding in managing computer network. With increasing faults and attacks on network infrastructure, there is an urgent need to analyze networks and services vulnerabilities under organize fault attack.

Vulnerability is flaw or weakness in a system's design, implementation or operation and management that could be exploited (Qu et al., 2001). Network vulnerabilities refer to the impact of attacks and fault on computer network. It is a point where the network is susceptible to attack. The network vulnerabilities analysis is systematic examination of computer network to determine the adequacy of security measures, identify security deficiencies, provide data from which to predict the effectiveness of proposed security measures, and confirm the adequacy of such measures after implementation.

Identifying organizational network vulnerabilities is a part of vulnerability risk assessment. Identifying vulnerabilities in enterprises can be divided into two step vulnerabilities by asset and vulnerabilities by class (Myerson, 2002). Traditional assets are consists of hardware, software, network and communications, human resource, facilities, data mechanism, disaster recovery procedures, and organizational resources. Each assets have a different vulnerabilities and poses different set of test. Vulnerabilities by class is identified by a group of assets into classes that from a

threat. Network vulnerabilities analysis (NVA) performs a systematic test on the wireless network to identify any threats.

One way of protecting the corporate information system is to reduce, mitigate or eliminate the risk of actual threats from occurring by doing some good risk management program and treat it as number one priority for security policy and each risk assessment process consists of five variables: assets, threats, vulnerabilities, risks and control (Myerson, 2002).

WLAN VULNERABILITIES

The security services are provided largely by the Wired Equivalent Privacy (WEP) protocol to protect link-level data during wireless transmission between clients and the access points. WEP does not provide end-to-end security, but only for the wireless portion of the connection (Karygiannis & Owens, 2002).

WLANs are vulnerable and it is a good idea to follow a few simple tips to better protect your WLAN. Hackers are smart too but when your WLAN is protected, they may get frustrated and give up. Key problem with existing 802.11 are listed below (Karygiannis & Owens, 2002)

- Security features in vendor products are frequently not enabled - Security features, albeit poor in some cases are not enabled when shipped, and users do not enable when installed. Bad security is generally better than no security.
- Initial Vector (IV)s are short (or static) - 24-bit IVs cause the generated key stream to repeat. Repetition allows easy decryption of data for a moderately sophisticated adversary.
- Cryptographic keys are short - 40-bit keys are inadequate for any system. It is generally accepted that key sizes should be greater than 80 bits in length. The longer the key, the less likely a comprise is possible from a brute-force attack.
- Cryptographic keys are shared - Keys that are shared can compromise a system. As the number of people sharing the key grows, the security risks also grow. A fundamental tenant of cryptography is that the security of a system is largely dependent on the secrecy of the keys.
- Cryptographic keys cannot be updated automatically and frequently - Cryptographic keys should be changed often to prevent brute-force attacks.
- Rivest Cipher 4 (RC4) has a weak key schedule and is inappropriately used in WEP - The combination of revealing 24 key bits in the IV and a weakness in the initial few bytes of the RC4 key stream leads to an efficient attack that recovers the key. Most other applications of RC4 do not expose the weaknesses of RC4 because they do not reveal key bits and do not restart the key schedule for every packet. This attack is available to moderately sophisticated adversaries
- Packet integrity is poor - Cyclic Redundancy Check 32 (CRC32) and other linear block codes are inadequate for providing cryptographic integrity. Message modi cation is possible. Linear codes are inadequate for the protection against advertent attacks on data integrity. Cryptographic protection is required to prevent deliberate attacks. Use of non-cryptographic protocols often facilitates attacks against the cryptography.
- No user authentication occurs - Only the device is authenticated. A device that is stolen can access the network.

- Authentication is not enabled; only simple Service Set Identifier (SSID) identification occurs - Identity-based systems are highly vulnerable particularly in a wireless system because signals can be more easily intercepted.
- Device authentication is simple shared-key challenge-response - One-way challenge-response authentication is subject to "man-in the-middle" attacks. Mutual authentication is required to provide verification that users and the network are legitimate.
- The client does not authenticate the access point (AP) - The client needs to authenticate the AP to ensure that it is legitimate and prevent the introduction of rogue APs.

According to CERT® Coordination Center the number of vulnerability reports rose from 171 in 1998 to 1090 by 2000 and 633 by first quarter of 2001 (Myerson, 2002). According to Fortinet Inc's director, today's wireless security standards such as Wired Equivalent Privacy (WEP) and Wi-Fi protected access (WPA) protect the privacy of wireless connection via encryption, and ensure that only authorized users can connect to a wireless access point but once connected, even if encrypted can easily deliver content threats into wired network. One of the biggest communications company in country also follows the same step by not having a hotspot security applications in place because it is a public service and users have to take their own security.

RELATED WORK

Mobility that wireless technology provides has facilitated some security vulnerabilities and malicious attacks. Even with good internal security practices such as firewalls and virus protection, campus networks are still vulnerable to malware, since wireless access on college campuses allows the spread of computer viruses and worms due to laptops moving between campus and less-protected networks (Higby & Bailey, 2004). The traditional ways of protecting network for wired environments are no longer sufficient (Zhang et al., 2003).

Wireless local area networks provide a luxury of mobility to clients so that they may roam without the restriction of wires, room and/or buildings. At the same time, wireless local area networks have given birth to a new breed of network weaknesses that are compounding and exploiting current local area network vulnerabilities (Higby & Bailey, 2004). Wireless access on college campuses facilitates the spread of computer viruses and worms due to laptops that do not have current software patches and/or antivirus protection connecting to the network (Higby & Bailey, 2004).

The nature of mobile computing environment makes it very vulnerable to an adversary's malicious attacks. The use of wireless links renders the network susceptible to attacks ranging from passive eavesdropping to active interfering. Unlike wired networks where an adversary must gain physical accesses to the network wires or pass through several lines of defense at firewalls and gateways. Attack on a wireless network can come from all directions and target at any node. Damages can include leaking secret information, messages contamination and node impersonation. It means wireless network will not have a clear line of defense, and every node must be prepared for encounters with an adversary directly or indirectly (Zhang et al., 2003).

WarDriving is "the act of moving around a specific area and mapping the population of wireless access points for statistical purposes" (Hurley et al., 2005). WarDriving, also called access point

mapping, is the act of locating and possibly exploiting connections to wireless local area networks while driving around a city or elsewhere. It is important to note that the definition of WarDriving is not exclusive to driving around in a car. (Hurley et al., 2005) explained that "WarDriving can be accomplished by anyone moving around a certain area looking for data." People have "war drived" simply by walking around a neighborhood with a Personal Digital Assistant (PDA), or using a laptop while taking a taxi or the subway.

WarDriving is a process which an individual uses a wireless device such as a laptop or PDA to drive around looking for wireless networks (Johnson, 2005). Some people do this as a hobby and map out different wireless networks which they found. Other people, who can be considered hackers, will look for wireless networks and then break into the networks. If a wireless is not secure, it can be fairly easy to break into the network and obtain confidential information. Even with security, hackers can break the security and hack.

According to (Duntemann, 2003), a WarDriving is gathering of statistics about wireless networks in a given area by listening for their publicly available broadcast beacons. Wireless access points (APs) announce their presence at set intervals (usually 100 milliseconds) by broadcasting a packet containing their service set identifier (SSID) and several other data items. A stumbling utility running on a portable computer of some sort (a laptop or PDA) listens for these broadcasts and records the data that the AP makes publicly available.

The term is the offspring of the term wardialing, which was the practice of dialing random phone numbers via computer to find an answer modem. WarDriving provides a unique opportunity to gauge the growth of a technology market segment by direct inspection. In other words, we do not have to take a vendor's or research firm's word for how many wireless networks are out there.

It is important to understand the common threats that wireless network can face (Microsoft, 2006). The issues of vulnerabilities are explained below:

a. Disclosure of data through eavesdropping - Eavesdropping attacks on wireless traffic that is not secure can result in the disclosure of confidential data, discovery of user credentials, and can even lead to identity theft. Sophisticated attackers can use information collecting by eavesdropping to mount attacks on systems that would not otherwise be vulnerable.
b. Interception and modification of transmitted data An attacker who can gain access to network resources is also capable of inserting rogue systems into a network that can intercept and modify data en-route between two legitimate systems.
c. Spoofing - Access to an internal network provides an attacker with the opportunity to forge data so that it appears to be legitimate traffic. Such attacks can include spoofed e-mail messages that would be trusted by internal users more readily than communications from outside sources, thus providing a platform for social engineering attacks and Trojan insertions.
d. Denial of services (DoS) - No matter what security solution is implemented; a WLAN is uniquely susceptible to DoS attacks whether purposeful or accidental. Such disruptions can be the result of something as simple as a microwave oven or a device set to flood a network with indiscriminate traffic.
e. Free-loading (resource theft) - Some intruders might be after nothing more than free access to the Internet. Though not directly malicious or damaging, such activities can result in slower network connectivity for legitimate users or an unmanaged vector for malware test.

f. Accidental threats and unmanaged connections – In unsecured WLAN environments any visitor can gain access to the internal network simply by starting up a device that is capable of accessing wireless networks. Such unmanaged devices could already be compromised or supply an attacker with vulnerable point of attack against a network.
g. Rogue WLAN access points - Even if a business has no wireless network it can still be vulnerable to security threats from unmanaged wireless networks. Wireless hardware is relatively inexpensive so any employee could possibly set up an unmanaged and unprotected network within an environment.

VULNERABILITIES DISCOVERY

The WarDriving activities need to have a vehicle, a computer; which can be a laptop, a wireless Ethernet card set to work in promiscuous mode, and some kind of an antenna which can be mounted on top of or positioned inside the car. Because a wireless LAN may have a range that extends beyond an office building, an outside user may be able to intrude into the network, obtain a free Internet connection, and possibly gain access to company records and other resources.
What most needed to WarDriving includes the following (Duntemann, 2003): A computer you can haul around with you. Most people use laptops. Some use PDAs based on the PocketPC OS or Linux. First, a "stumbler" utility. By far the best known is Marius Milner's Network Stumbler for Windows, which most people call NetStumbler. Most major operating systems have stumbler programs available. Linux has Kismet; MAC OS has MacStumbler. Marius has ported NetStumbler to PocketPC, for which it's called MiniStumbler. Second, a Wi-Fi client adapter supported by your chosen stumbler utility. Third, an external antenna attached to your client adapter. Ideally, this is an omnidirectional vertical mounted on the vehicle roof. These are small and resemble cell phone antennas. We can wardrive with nothing more than a PC card's built-in antenna, but these antennas are wretched and will be shielded from signals to some extent by the vehicle's metal structure. Fourth, a Global Positioning System (GPS) receiver that emits National Marine Electronics Association (NMEA) 183 formatted data. This allows the Netstumbler program to record where stumbled stations are located in the physical world. Technically, GPS is optional, but the stumbled data is much less useful without GPS information. Finally, a Wireless Network Interface Card (Lucent ORiNOCO cards recommended)

VULNERABILITIES ASSESSMENT

Wireless Vulnerabilities Assessment (WVA) can be divided into two phases which are Vulnerability Testing and Vulnerability Analysis.

Vulnerability Testing

Network penetration testing means using tools and processes to scan the network environment for vulnerabilities. This helps refine an enterprise's security policy, identify vulnerabilities, and ensure that the security implementation actually provides the protection that the enterprise requires and expects. Regularly performing penetration tests helps enterprises uncover network security weaknesses that can lead to data or equipment being compromised or destroyed by exploits attacks

on a network, usually by "exploiting" a vulnerability of the system),Trojans (viruses), denial of service attacks, and other intrusions. Testing also exposes vulnerabilities that may be introduced by patches and updates or by misconfigurations on servers, routers, and firewalls.

VULNERABILITY ANALYSIS

The result generated from the report is needed to be analyzed. The report provides host by host security risk information and also overall security weakness in the network. It can provide us much more detail vulnerabilities on the network. From the analyzed report, the overall conclusion can be used as guideline in determine the security level faces by the organization and the types of remedies and prevention can be taken to secure the network.

In practice, the need for vulnerability analysis is universally acknowledged. Commercial vulnerability scanners are good at identifying known vulnerabilities in the software. However, identifying vulnerabilities is only a small part of securing a network, and a significant issue is identifying which vulnerabilities an attacker can take advantage of through a chain of exploits. There are numerous examples of such chains in the research literature. In summary, each host on a network (hosting services or client to network services, or even accessing email messages) is expected to expose vulnerabilities to the outside world. Plugging all network vulnerabilities based on the output of a vulnerability scanning tool may render a network unusable to users. Hence there is a need for vulnerability analysis of the complete network (combining all the network applications and hosts) to chain exploits on each host to find out the reach of the attacker. Such analysis is useful since it not only pin points most serious vulnerabilities on a network which must be plugged, but also gives a basis for decision making on the placement and security of valuable resources.

RESULT AND DISCUSSION

Data captured was done twice, 25-01-2007 and 19-09-2007. As previously mentioned, WarDriving was used to capture the data. All data was analyzed separately according to two different times (first and second data captured). Consequently, plotting was done using Google Maps with the support from GPSVisualizers.com and data analysis was done using NetStumbler data report.

6.1 First Capture (25-01-2007)

Fig.1 shows a map created by using visualize base on first data capture (25-01-2007) in UUM. The pointers on the map showed the locations of every APs available. Table 1 shows the summary of the data capture such as total of access point and ad hoc, encryption off/on, and default SSID. Based on the data, total of access point were 38 units and ad hoc were 7 units. However, all of the numbers (access point and ad hoc devices) are Encryption OFF (open mode) which means no access security key (password) is needed and anybody can easily access through the access point device. Four access points had been detected for using default of the service set identities (SSID). Moreover from 45, 29 were legal APs and the rest were unauthorized APs (rogue AP).

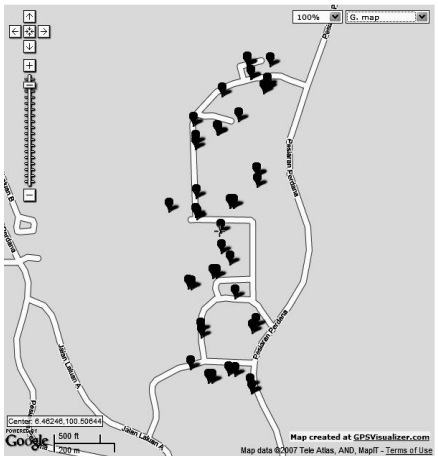

Figure 1: GPS Map First Data Captured

Table 1 shows the summary of the first data capture such as total of access point and ad hoc, encryption off/on, and default SSID. Fig. 2 shows the bar graph for two types of access points and Fig. 3 shows the number of access points which encryption enabled for the first data capture.

Table 1: Data Captured

Categories	No.
ALL (AP & Ad-hoc)	45
Encryption OFF	45
Encryption ON	0
Access Point	38
Ad-hoc	7
Default SSID	4
Authorize AP	29

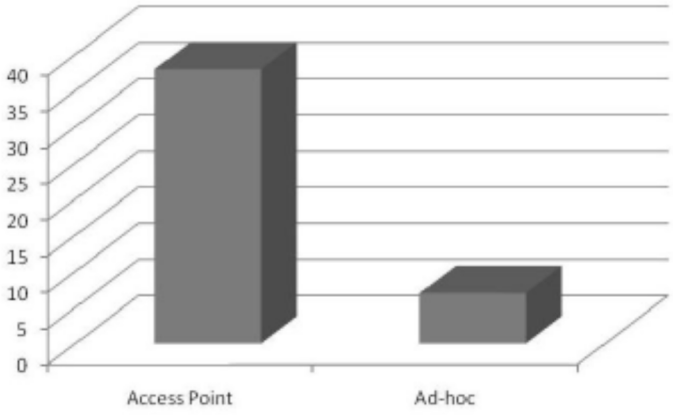

Figure 2: First Captured: AP or Ad hoc

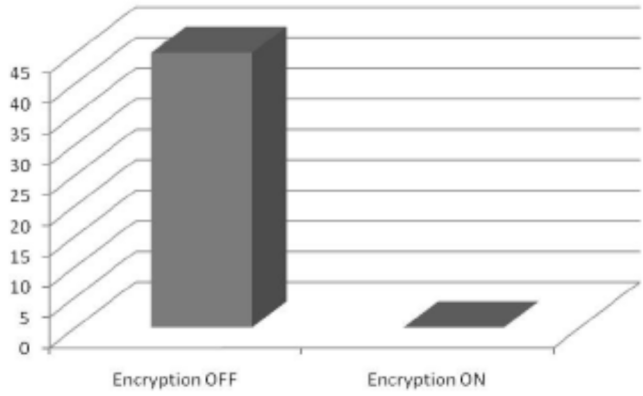

Figure 3: First Captured: Encryption Mode OFF/ON

6.2 Second Capture (19-09-2007)

Fig. 4 shows the location of access point and ad-hoc point captured by using NetStumbler.

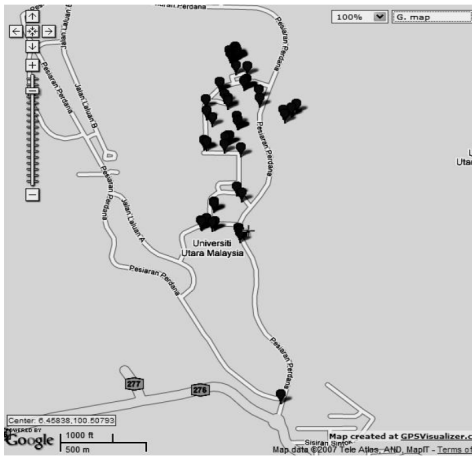

Figure 4: GPS Map Second Data Captured

Table 2 shows the summary of the Second data capture such as total of access point and ad hoc, encryption off/on, and default SSID.

Table 2: Data Captured

Categories	No.
ALL (AP & Ad-hoc)	74
Encryption OFF	72
Encryption ON	2
Access Point	45

Table 2 is the summary of our findings for second capture (19-9-2007). It stated that total for all points (APs and Ad-hoc) were 74 whereas number of access points were 45 and Ad-hoc were 29. However from the total of 74, only 2 points apply security mechanism by switching the

encryption ON and 72 points were encryption OFF. The summary also revealed that 4 points used default SSID. Only 35 were legal APs and the rest were unauthorized APs (rogue AP). Fig. 5 shows the bar graph for two types of access points and Fig. 6 shows the number of access points which encryption enabled for the second data capture.

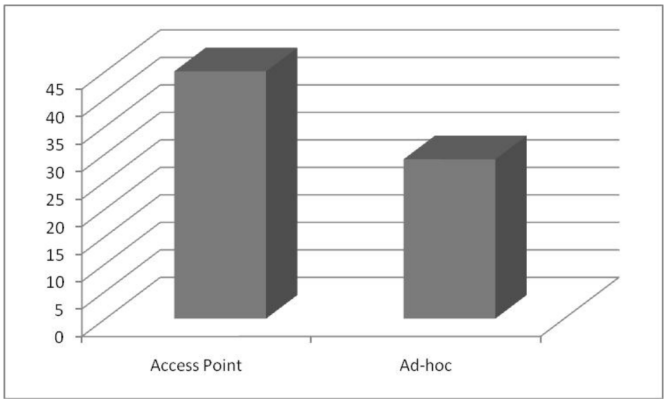

Figure 5: Second Captured: AP or Ad hoc

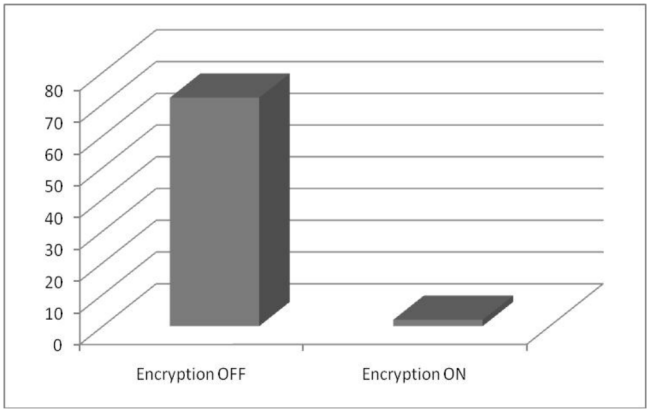

Figure 6: Second Captured: Encryption Mode OFF/ON

DISCUSSION

The result showed that, the increasing of all points was 61% (from 45 to 74 units). It was about 6% (3 units) for each month (starting from January until September). It is caused of the demand for connecting into network using wireless, increased dramatically. Another assumption was the increasing of student that owned a notebook with wireless capability also contributed to these issues. Our next discussion focused on security issues. Only 2 units were discovered using encryption (occurred in second data captured). This contributed about 2% whereas another 98% were not encrypted (open vulnerabilities to the network). Anyone can access the network without to authorize themselves. There were several APs which were setup by computer center without encryption enabled. This will give an opportunity to intruder to manipulate the situation for their own purposes. Moreover, unregulated or rogue APs were also discovered in our network environment. As a result, it will increase the level of vulnerabilities to the network environment.

We also discovered that 16% of points were ad-hoc in first data capture and 39% in second data capture. While APs which used default SSID was 5% (first data capture) and 8% (second data capture) only. Lastly, from both data capture, we found that 40% to 50% were authorized APs and the rest considered rogue APs. We also discovered that it was several Ad hoc type wireless communications involved. Even though it is legal, it will give an opportunity to unauthorized user for manipulating our network.

REMEDY

From the discussion we conclude that the vulnerabilities are elsewhere waiting to be manipulated. Some action should be taken before it is become worst. We suggest two types of solution to overcome the problems: Using WPA or WPA2 and implementing 802.1X (RADIUS).

Using WPA or WPA2

Instead of OPEN and Shared AP, with 100% vulnerabilities, the management should change to CLOSE AP which implementing encryption as a secure access to each user. WEP is not a good choice encryptions mechanism however WPA/WPA2 are better as a security barrier between WLAN and LAN.

Implementing 802.1X (RADIUS)

Another option is implementing 802.1X. As an enterprise security perimeter, this option is crucial in preventing any unauthorized user from entering into network environment. Fig. 7 shows two steps how 802.1X works: Authenticating and access granting. AP will route the authentication process to RADIUS. If user is valid then AP will open connection to any server that permitted to the users.

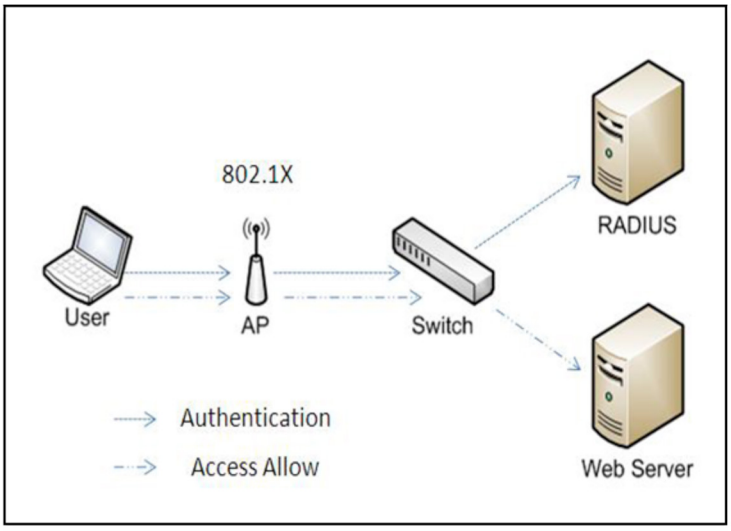

Figure 7: 802.1X

APs without proper configuration will increase the vulnerabilities to network environment. During WarDriving session a few important factors had been found such as the number of APs and Ad hoc that not used any security method and several used default SSID. Some action should be taken aggressively to negate the problem in near future especially by implementing either WPA/WPA2 or 802.1X as the enterprise solution to prevent unauthorized user.

RECOMMENDATION AND CONCLUSION

From the discussion we conclude that the vulnerabilities are elsewhere waiting to be manipulated. Some action should be taken before it is becoming worst. We suggest two types of solution to overcome the problems; using WPA or WPA2 and implementing 802.1x Remote Authentication Dial In User Service (RADIUS). The first solution is by using WPA or WPA2. Instead of OPEN and Shared AP, with 100% vulnerabilities, the management should change to CLOSE AP which implementing encryption as a secure access to each user. WEP is not a good choice encryptions mechanism however WPA/WPA2 is better as a security barrier between WLAN and LAN. Another option is implementing 802.1X (RADIUS). As an enterprise security perimeter, this option is crucial in preventing any unauthorized user from entering into network environment. Placing APs without proper configuration will increase the vulnerabilities to network environment. During War Driving session a few important factors had been found such as the number of APs and Ad-hoc that not used any security method and several used default SSID. Some action should be taken aggressively to negate the problem in near future especially by implementing either WPA/WPA2 or 802.1X as the enterprise solution to prevent unauthorized user.

Some recommendations have been proposed from this research. We urged Pusat Komputer to find a way to detect and disabled all rogue APs by buying a specific device or initiating a new research. This rogue APs will going to be a threats to UUM wireless environment. An 802.11 wireless network is very susceptible to a rogue APs attack. A rogue AP is one owned by an attacker that accepts wireless station connections and then at a minimum intercepts traffic. It also performs man-in the-middle attacks before allowing traffic to flow to the proper network. The goal of a rogue is to get valid traffic of the WLAN onto a wired network for attacking (or to conduct the attack directly within the rogue AP), and then reinsert the traffic into the proper network. Such rogue APs could readily be deployed in public areas as well as shared office space areas. They should also strengthen the security aspects of wireless environment. More security measures such as intrusion detection mechanisms need to be further explored.

The IEEE 802.11 group has provided a framework for access authentication and is fixing problems with WEP. For Wireless LAN authentication to be successful, additional authentication protocols that work with 802.1x and EAP must also be developed and deployed. To provide secure connections each new wireless LAN access must be authenticated and the authentication should result in a unique shared session key. The session key is used to provide message integrity between the wireless station and the AP.

RADIUS can be used as an authentication mechanism. Some APs provide the capability for checking the MAC address of the wireless station before allowing it to connect to the network. The AP may send a RADIUS request with the MAC address as the user id (and a null password) to a central RADIUS server and the RADIUS server will check the list. The RADIUS approach is especially appropriate if the MAC addresses are to be used with multiple APs.

In summary, by completing this research, we have revealed vulnerabilities in UUM wireless environment. Pusat Komputer must revise the security needs in UUM especially in wireless security. Too many rogue APs (unauthorized APs) overwrite security policies in UUM and access point without encryption-enable disclose messages to outsiders. It is important to educate wireless user to encrypt their messages in network so their messages remain confidential. Access authentication is also a critical part of secure wireless access. Without it, connections can be hijacked by impersonating the MAC address of any 802.11 devices other than an AP.

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Amran Ahmad, Ali Yusny Daud & Fazli Azzali
School of Computing
College of Arts and Sciences
Universiti Utara Malaysia,06010 Sintok, Kedah
{*amran, aliyusny, fazli*}*@uum.edu.my*
04-9284694, 04-9284645, 04-9284778

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The Effect of Information Quality in E-Learning System

Majed Mustafa Suliman Oun Alla & qais Faryadi

ABSTRACT

Information quality (IQ) is a term to describe the quality of the content of information system. Information quality is the main factor that increases or decreases the efficiency of information systems including e-learning system because of many factors that explained in this paper. The focuses of this studyaboutthe concept of information quality and discusses the main dimensions of information quality (Accuracy, Relevancy, Accessibility, and Validity) and evaluate the impacts of these dimensions on the efficiency of e-learning system. The study found that Accuracy is the strongest dimension that affects the information quality of e-learning system followed by Accessibility, Validity, and Relevancy respectively.

Keywords: E-learning System, Information Quality IQ,Accuracy, Relevancy, Accessibility, Validity.

INTRODUCTION

One of the emerging technologies in education is e-learning, which plays a significant in enhancing the educational means and increasing the degree of understanding. With the increased number of students in many developing countries, many higher-education institutions have introduced e-learning systems to replace the traditional educational methods and also saved cost and improved the degree of understanding of students, more over e-learning improve the delivery of course content and provide efficient and quick access to courses and subjects by both students and scholars (Al-Saif, 2005).

Nowadays quality is considered an essential issue for good education in general, and for e-learning in particular the quality of information could be a key success factor of the system (Williams, 2002). Moreover, quality of e-learning system cannot be expressed and set by a simple definition without understanding the details, since the term quality is a very abstract notion and bear various dimension such as system quality, service quality, and information quality.

This paper emphasize that efficiency of e-learning system could not be fulfilled without achieving high level of information quality that enhance student's awareness and understanding to the education courses. The specified background and the perception of e-learning users need to be taken into consideration when defining quality measures in e-learning. It is also important to classify criteria to address quality with regard to information access and accuracy (Stracke, 2006).

Many scholarshave showeda wide interest in studying information quality and evaluating its impact on information systems in different types of businesses and organizations, including

educational institutes. However taking into consideration that quality on the web for example is a complex concept to explain and measurebecause it is expected to be multidimensional in nature(Aladwani&Palvia, 2002), the same issue with information quality in e-learning, where the prime issue is to evaluate the quality of e-learning system as an information system, and therefore identifying the criteria by which the quality of this system is a reflection of the quality of information that provide for users (Buyukozkan, Ruan, &Feyzioglu, 2007). However, this paper will show that the criteria for measuring information quality are multidimensional such as speed of access to information, rich content, accuracy andclarity.

THE PURPOSE OF THE STUDY

This paper focuses on concepts of information quality and discusses the main dimensions of this concept and the impact of information quality on the efficiency of e-learning system in the context of content quality. The study particularly identify the key dimensions for information quality from the users' perspective so that to build a quality framework to measure and cold be applied by e-learning developers based on the concept of quality of the content provided by e-learning systems developers.

The study attempt to answer what makes e-learning successful? This question arises at the beginning of a large number of debates on the subject of quality in e-learning, and assumes that information quality is a fundamental element of e-learning system and the base for designing a any e-learning framework.

STUDY BACKGROUND

Software developers need to look beyond designing information system that has a good user interface, system quality, and efficient usability of the system, there is another important dimension they should realize and implement, which is information quality IQ. Moreover to their own discipline when designing and implementing learning software; they are in need to seek interdisciplinary exchange with authors, teachers, and learners. The question arises which characteristics are most important for good e-learning-environments and which providers offer the best performance at a reasonable price in a market that is continuously differentiating further. Learning, find themselves confronted with the continually progressing of the technological "delivery structure" of e-learning and are thus faced with an increasing learner orientation (Ehlers et al. 2004). This study will cover the context of information quality by analysing the main dimensions of information quality that affect the efficiency and performance of e-learning systems.

E-LEARNING

The term e-learning is used in literature and many commercial applications to explain the education fields, for example;web-based training courses, distributed learning, online learning, academic distance learning, virtual learning. Nowadays many well-known education institutes in Australia and United States provide e-learning for overseas students (Stracke, 2006).

During the last decade, e-learning was a different system that is applied nowadays. In general, most definitions for e-learning are used to explain the utilization of the technologies which can be used to deliver learningmaterials in an electronic format for seekers to information, the main waywas mainly via the internet (Gerhard &Mayr, 2002). Paulsen more generally describes online learning as "the use of a computer network to present or distribute some educational content" (Paulsen, 2002). In another definition of e-learning systems as "those methods that use the internet as a delivery medium for distributing and deliver static learning resources and information. (Psaromiligkos&Retalis, 2003) and most of the files was instructional files that were accessed and downloaded through an interface into interactive content environment.

This study emphasizes that previous definitions of e-learning look at e-learning in general and not discuss deeply the main dimensions of successful e-learning system as a new way for conducting education. In more detail, the study defines e-learning "a way to delivereducational courses in the form of informational blocksor course's objects and include synchronous or asynchronous interaction methods to deliver the information for the users.

There are two main types of e-learning: asynchronous and synchronous, depending on the interaction between learner (student) and system administrator(teacher). Synchronous e-learning environments require administrator (teacher). and learners or the online classmates to be online at the same time, where live interactions take place between them. However, the focus of our research will be on the case where students are logging into and using the system independently of other students and staff members. This fits firmly into the general definition of the asynchronous e-learning environment.

In this context, Doherty defined an Asynchronous Learning Network (ALN) as "a variety of e-learning systems which distribute learning courses (materials) in one direction and at a one time (Doherty, 1998). Another definition by Spencer & Hiltz (2001) express Asynchronous Learning Network ALN as "a place where learners (students) can interact with learning courses (materials)through the internet at different times and from different locations and not transferring information to on direction and at one time (Spencer & Hiltz, 2001).

The position adopted in this study is that e-learning deal with the technology used to distribute the learning course (materials). However, the quality of these courses (materials) and the interaction with learners depending on the quality of information provided by the e-learning system.

INFORMATIONQUALITYINE-LEARNING SYSTEM

Information quality (IQ) is a term to describe the quality of the content of information systems. It is often pragmatically defined as: "The fitness for use of the information provided." (Larry, 2009; Miller, 2010; Wang, 2007).

Although the evaluation of quality of e-learning systems through measuring the level of quality of learning materials and subjects have become increasingly important, but the evaluation of information quality (IQ) in e-learning systems is the most important quality dimension of e-learning system. The criteria to evaluate information quality ine-learning systems are differ from the evaluation of typical learning materials because the material and courses in e-learning is linked with other factors such as system usability and interface. Moreover, the specified context

and the perspectives of the users need to be considered when defining quality in an e-learning context. It is also important to define appropriate criteria to describe quality (Stracke, 2006). There are many criteria that can be used for evaluation of information quality system (Saleh, 2001;Macleod, 1998).

(Bakri, 1997) refers IQ in information system to any comprehensive reports should include all associated aspects of accuracy and any information should be free of errors information as two standards for the quality of information, while Cronin & Taylor, (2005) emphasized that information quality standards should fulfilthe objectives of e-learning system and satisfy user requirements to cover the whole courses required in a learning class and working properly without errors and to be easy for maintenance and development, provided that the educational benefit overcome the results of system existence cost.

In some studies, information quality has not been considered separately but as an integral part of user satisfaction (Bailey & Pearson, 1983) or user information satisfaction (Iivari, 1987). The measures that have been used for information quality are information accuracy (Bailey & Pearson 2008) information completeness, information relevance (King & Epstein, 2001) and information timeliness.

Although it is essential to set criteria and special standards for information quality for e-learning systems, this is a difficult and complex issue because there is no formal definition of information quality in general and for e-learning in particular. Literatures assumed that the standards of information quality in e-learning systems represent by the following:

1. Accuracy: correct information and data provided to the students and beneficiary from the e-learning system.
2. Renewal: the ability of updated literatures in a timely manner.
3. Integrity: the availability of sufficient information necessary for a specific purpose.
4. Briefly: summary of information in exception or activities planned as needed.
5. Availability of information: to be available and easily accessible by the user (student) or the administrator (teacher).

THE CONCEPTOF QUALITY IN E-LEARNING SYSTEM

Quality can be viewed and considered from different aspects. In this context the SunTrust Equitable report (Humphreys, &Ruttenbur, 2000) illustrates what they perceive to be the value chain in e-learning in the form of a pyramid. Content is the most critical factor of e-learning as it forms the base of the value pyramid. In fact, to be able to use the internet as a tool to improve learning, the content should not distract learners, but increase their interest for learning. Learning tools and enablers are also important in the learning procedure. In reality, providers of learning platforms and knowledge management systems are key factors in the successful delivery of content, also the providers need a good infrastructure to deliver learning content. The efficiency of e-learning system is represented in three fundamental dimensions: quality, technology, access. However, the focus in this study will be on the quality of information, which is considered an essential element for education in general and not only in online and electronic education. Moreover, quality is an important term with wide expressions that cannot be expressed and set by a simple definition, because quality is a very conceptual notion.

It is important to acknowledge that quality of a learning process is not something that is delivered to a learner by an e-learning provider but rather constitutes a process of co-production between the learner and the learning-environment. That means that the product/ outcome of an educational process is not exclusively a result of the production process of an educational institution. Quality therefore has to do with empowering and enabling the learner. It has to be defined at the final position of the provision of the learning-services: the learner. The article describes learners preferences in e-learning based on empirical results of today's largest survey in this field (Ehlers, 2002).. It thus facilitates the construction of learner oriented services portfolios in e-learning.

RESEARCH METHODOLOGY

This evaluation of information technology in e-learning system was a cross-section survey performed on a sample selected from a population of students and teachers involved in academic work using e-learning or online learning methods in a regular basis. Participant was exclusively learners and teachers. The questionnaire was distributed to the participants via e-mail because of fast response and low cost, and need for short time to collect informationand data. The study used software application in Surveymethods.com and utilized an online survey, deploy the questionnaire via e-mail, and collect data and make analysis to the collected data from the participants through its graphical chartsand professional based analysis modules. The questionnaire was divided to three parts:

- Part 1: A brief profile and demographic data of participants.
- Part 2: Addresses the user's perception and attitude of e- learning systems and information quality in particular.
- Part 3: Askparticipants to rank dimensions of information quality from the perspective of e-learning.

The study analysed the collected data from part 3 in the questionnaire using SPSS software package to identify impact of information quality dimensions on the efficiency of e-learning systems and to build the final quality conclusion and future framework.

The Research Hypothesis

The study attempt to verify the following two hypotheses:

- **H1:** There is a positive relationship between Accuracy, Relevancy, Accessibility, and Validitywith information quality in e-learning system.
- **H2:** There is a statistical relationship between information quality and the efficiency of e-learning system

THE STUDY FRAMEWORK

The study assumes that information quality affect the efficiency of e-learning systems through four dimensions (Accuracy, Relevancy, Accessibility, and Validity), and therefore the study evaluated each dimensions from the perspective of learners and teachers. The relationships between the study variables are shown in Figure-1 below:

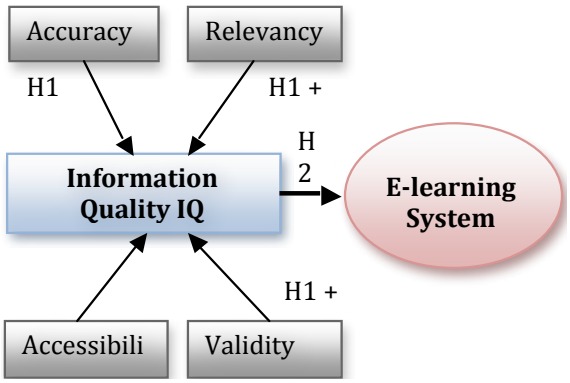

Figure 1: The relationship between study variables

RESULT AND DISCUSSION

First, we conducted a frequency analysis for each dimension to check for major errors and possible missing values. The results obtained for the analysis ofvariables frequency in each of the four dimension (Accuracy, Relevancy, Accessibility, and Validity) show that the data is valid and reliable for the analysis. . The values of Cronbach's alpha for the four quality dimensions gave an acceptable reliability value with 0.612, 0.785, 0.691, and 0.711and for Accuracy, Relevancy, Accessibility, and Validityrespectively.

The following analysis shows the perspective of participant of learners and teachers on each quality dimension.

Accuracy

Accuracy is essential to teach the students and learners the right information without mistakes and errors. The data are deemed of high quality if they correctly represent the real-world construct to which they refer (Eckerson, 2002).

The study measured the impact of Accuracy on the level of understanding of learners and students using e-learning systems.

The result showed that among the 179 participants; (99participants agree, 34participantsstrongly agree, 21participantsneutral, 11participants disagree, 14participants strongly disagree), The overall percentage of participants as follow;(55% agree, 19% strongly agree, 12% neutral, 6% disagree, 8% strongly disagree) as shown in Fig-2 below.

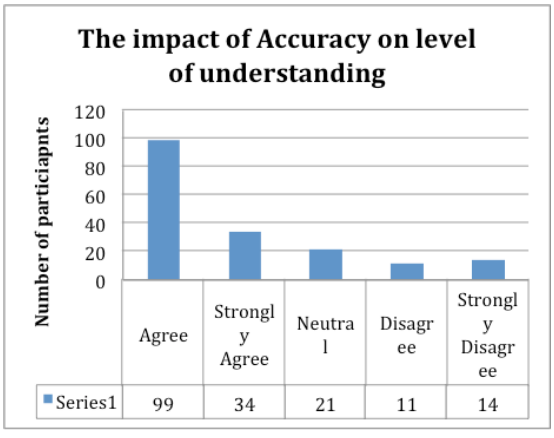

Figure 2: Information Accuracy

The result shows that the majority of participants agree that the accuracy of information is very important to increase the level of understanding of learners and students. The mean value equal to 2.1 and standard deviation 0.33, which means most learners prefer higher accuracy from the online courses provided by e-learning system.Data are of high quality "if they are fit for their intended uses in operations, decision making and planning" (J. M. Juran, 2004).

Relevancy

Relevancy of data denotes how well retrieved information or set of literatures documents meets the information needed by the learner. Relevance may include concerns such as timeliness, authority or novelty of the result (Dan Sperber, 2001).

The study measured the impact of relevancy on learners' perception about the quality of e-learning systems.The result showed that among the 179 participants; (84 participants agree, 79participants strongly agree, 5 participants neutral, 4 participants disagree, 7 participants strongly disagree), The overall percentage of participants as follow;(47% agree, 44% strongly agree, 3% neutral, 2% disagree, 4% strongly disagree) as shown in Fig-2 below

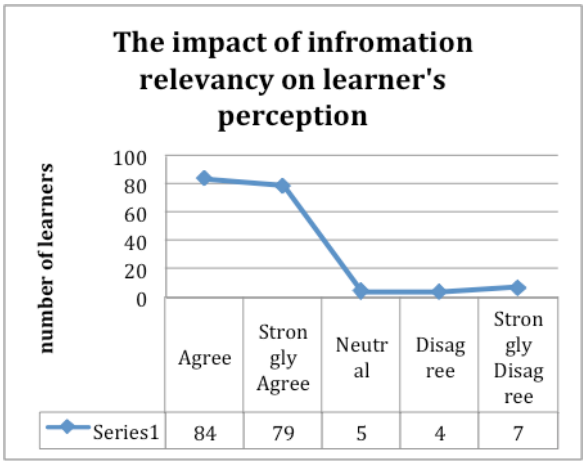

Figure 3. Information Relevancy

This result shows the significance difference between the participants, and that 91% of participants who either agree or strongly agree. The mean value equal to 1.8 and standard deviation 0.23 approve this result and increase the reliability of hypothesis H1, which states that information relevancy has a positive relationship with information quality in e-learning system. Recently, Zhao and Callan (2010) showed a connection between the relevance information and the understandingmismatch problem in retrieval, which could lead to reduce data retrieval accuracy.

Accessibility

This study attempts to address the impact of accessibility on information quality and examine the accessibility dimension. Over the last number of years, access methods to information systems have also evolved and many studies showed the importance of accessibility on information quality and enhancing the perception and acceptance of the learners. This has resulted in a diverse number of architectures accessing multiple information systems. Providing efficient learning systems

require effective way to access for information. Therefore this study concluded that accessibility is an influence on information quality.

The study measured the impact of accessibility on information quality according to the opinion of students and teachers participated in the survey. The result showed 51% agree, 24% strongly agree, 0% neutral, 13% disagree, 12% strongly disagree) as shown in Fig-4 below

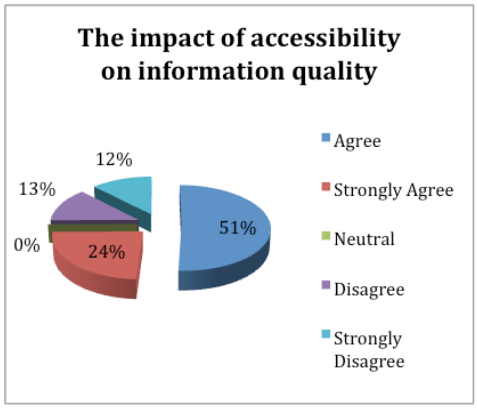

Figure4. Information Accessibility

It is clear that the majority of participants confirmed that they need for accessible information and easy to reach for the course they need when using the e-learning system, this opinion is shared with the operator of e-learning systems, who emphasized on the importance of easy access to the required course and needing for short time to locate the information they need, and this issue has a positive impression on the learners.

Validity

Information can sometimes be problematic. It is always important for the information professional and scholars to validate information before accepting it a source for learning. However, the information found in reference books and other printed materials in public libraries has usually undergone a rigorous selection process. Thus some of the validation of information has already taken place through the selection process, and the same meaning apply on e-learning where electronic source of information must provide valid information.

The result shows that 49% agree, 31% strongly agree, 7% neutral, 8% disagree, 5% strongly disagree) as shown in Fig-5 below

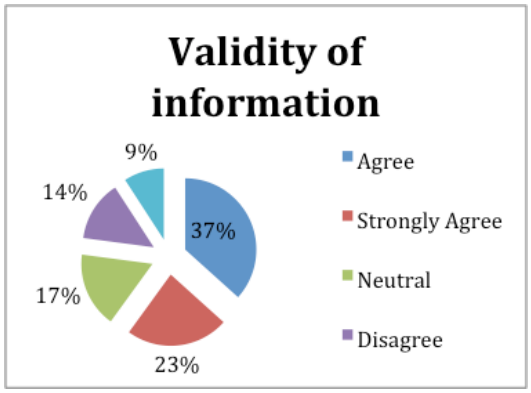

Figure5. Information validity

The participants confirmed that validity is highly important to consider the information they receive from the e-learning system is reliable. Information provided by the e-learning system must be updated and the system need for frequent update to all saved courses and literatures with mostly updated in order to ensure high quality of information at any time.

CONCLUSION AND FUTURE WORK

This paper emphasize that efficiency of e-learning system could not be fulfilled without achieving high level of information quality that enhance student's awareness and understanding to the education courses.

The study concluded that information quality is the main factor that increase or decrease the efficiency of e-learning system and therefore e-learning systems developers should take consideration on the dimensions of information quality (Accuracy, Relevancy, Accessibility, and Validity).The accuracy of information where found the strongest dimension that affect the information quality followed by Accessibility, Validity, and Relevancy respectively.

The study recommends that future studies should conduct further evaluation to other dimensions such as objectivity, completeness, and consistency, also examine the relationship between system interface and information quality.

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Majed Mustafa Suliman Oun Alla
Faculty Science andTechnology, University Sains Islam Malaysia
Majed_manofwar@yahoo.co.uk +60147199167

Dr.qais Faryadi
Faculty Science and Technology, University Sains Islam Malaysia
Qais@usim.edu.my +60122963644

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A New Approach to Functionalize Multi-Walled Carbon Nanotubes using Aminopropyltriethoxysilane

Junidah Abdul Shukor & Azizan Aziz

ABSTRACT

This work presents a comparison of two different silanization procedures on multiwalled carbon nanotubes (MWCNT). In order to minimize the formation of defects during the treatment, a new approach to functionalize MWCT with aminopropyltriethoxysilane (APTES) through radical addition onto MWCNT surface using benzoyl peroxide (BPO) as initiator has been established. This radical-silanization process was performed at 110 ^{0}C to induce thermal decomposition of BPO into phenyl free radicals. The phenyl free radicals initiated direct functionalization by means of creating reactive site on the surface of MWCNT as well as on APTES. The effectiveness of radical-silanization treatment has been compared with oxidation-silanzation treatment. The presence of the silane molecules on the surface of MWCNT was confirmed by Fourier transform infrared spectroscopy (FTIR). Thorough study by Thermogravimetric analysis (TGA), radical-silanization treatment revealed a significantly increased thermal stability of MWCNT than oxidized-silanized MWCNT. Raman spectroscopy and TGA were employed to estimate the degree of functionalization. This was further confirmed by morphology study using Transmission Electron Microscope (TEM).

Keyword: Oxidation treatment, free radical reaction, silanization, Multi-walled Carbon Nanotubes (MWCNT), Aminopropyltriethoxysilane (APTES).

ABSTRAK

Kajian ini membentangkan perbandingan dua prosedur pengsilanan berbeza terhadap nanotiub karbon berbilang (MWCNT). Dalam usaha untuk mengurangkan pembentukkan kecacatan semasa rawatan, satu pendekatan baru untuk memfungsionalisasikan MWCNT dengan aminopropyltriethoxysilane (APTES) melalui penambahan radikal ke permukaan MWCNT mengunakan benzoyl peroksida (BPO) sebagai pemula telah dibangunkan. Radikal-pengsilanan ini telah dilaksanakan pada 110 ^{0}C untuk membenarkan penguraian terma BPO kepada radikal bebas phenil. Radikal bebas phenil memulakan pengfungsionalisasi langsung sebagai suatu keadah untuk mengwujudkan kawasan aktif di permukaan MWCNT begitu juga pada APTES. Keupayaan rawatan radikal-pengsilanan telah dibandingkan dengan rawatan pengoksidaan-pengsilanan. Kewujudan molekul silane pada permukaan MWCNT telah disahkan dengan spektroskopi inframerah transformasi fourier (FTIR). Kajian terperinci dengan Thermogravimetri analisis (TGA), rawatan radikal-pengsilanan telah diperhatikan ketara meningkatkan kestabilan haba MWCNT berbanding MWCNT teroksida-tersilane. Spektroskopi Raman dan TGA telah digunakan untuk menganggarkan tahap fungsionalisasi. Kaedah ini seterusnya disahkan dengan kajian morfologi menggunakan mikroskop imbasan electron (TEM).

Kata kunci: *Raawatan pengoksidaan, tindakbalas radikal bebas, pengsilanan, karbon nanotiub berbilang (MWCNT), Aminopropyltriethoxysialne (APTES).*

INTRODUCTION

Carbon Nanotubes (CNT), tubular shells of graphitic sheet is carbon allotrope suddenly discovered during synthesis of fullerene C_{60} [1]. Since their discovery in 1991, tremendous amount of study on CNT has being done on various aspects including synthesis, treatment, properties and applications. However there are still many challenges facing the applications of CNT that need to be overcome [2,3]. In fact, most researchers had highlighted one of the challenges is to create chemical linkages and compatibility with other substance such as in composite materials [4].

One of the solutions to this crucial issue is functionalization on the perfect structure of CNT. Covalent functionalization using organosilane have widely used to functionalize the surface of CNT. Organosilane is the coupling agent that is commonly proposed to be utilized as mediator between incompatible materials [4-6]. The aim is to allow CNT linked with organosilane molecule in order to improve CNT compatibility with other polymer for the application in CNT/ based polymer nanocomposites. However the structures of CNT need to be altered to allow the attachment of organosilane on the surface of nanotubes. Oxidation treatment by strong acid is a common procedure used to generate mainly –OH and –COOH functional groups on the CNT surface before silanization treatment on the nanotubes can be carried out [2,4,6].

Unfortunately, several study have demonstrated that the usage of oxidation treatment tend to create large number of defects on the CNT structure such as, open end-cap tube, cutting the length of CNT, consequently reduced the aspect ratio of nanotubes [2-4,6]. Recently a few of researchers suggested the direct functionalization without undergoing oxidation treatment as an alternative way of attaching silane group on the CNT. The process adopted can be silylation [7], direct silanization [8], and hydrosilylation process [9]. Based on these approaches, a new way to functionalize organofunctional silane on CNT using radical addition as direct functionalization has been proposed in the present study.

This method is proposed to minimize new defect formation on the intrinsic defect of CNT. The ability of radical treatment tend to yield less defect creation on nanotubes [10,11], can be utilized as an alternative to overcome the weakness of oxidation treatment. Therefore in the present study, aminopropyltriethoxysilane (APTES) was used as silane coupling agent to treat MWCNT via radical-silanization. The treatment will be initiated by benzoyl peroxide (BPO), with the aim to create less number of defects besides as an alternative way to covalently grafting the APTES on the nanotubes surface.

Thermolysis decomposition of BPO at high temperature allows the initial homolysis of the O-O bond in BPO molecule into benzoate free radicals followed by fragmentation into carbon dioxide and yield phenyl radicals [12,13]. The benzoate and phenyl free radicals have the possibility to create reactive site on MWCNT surface and initiate polymerization of APTES. It is found that, during polymerization of APTES, radical sites are generated on the aminosilane [14] and have possibility to terminate the reactive site of MWCNT surface. The ability and the effectiveness of radical silanization treatment in this study will be compared with oxidation-silanization treatment.

EXPERIMENTAL

Materials

MWCNT was purchased from Shen Zhen nanotech Port Co. Ltd., China synthesized by chemical vapor deposition (CVD) with purity ≥95%. The diameter and length are in the range between 10-20nm and 1-2 μm respectively. APTES was obtained from Sigma Adrich used as silane functional agent. The following reagents were used without further purification: sulfuric acid (H_2SO_4; 97%, Merck), nitric acid (HNO_3; 70%, J.T. Baker), sodium hydroxide (NaOH, Merck), benzoyl peroxide (~25% moisture content, Merck), toluene (>99%, Merck) and acetone (>99%, Merck).

Experimetal Procedure

Oxidation-silanization Treatment

For oxidation treatment, 0.5 g of MWCNT was dispersed in 160 ml of concentrated H_2SO_4/HNO_3 (3:1 v/v) solution at room temperature and stirred for 4 hrs under reflux condition. The solution was neutralized with NAOH before filtered and washed with de-ionized water until reach pH-7. The resulting oxidized MWCNT (O-MWCNT) were then dried under vacuum at 100 ^{0}C for 12 hrs. Then followed by silanization; the O-MWCNT was dispersed in 50 ml of toluene and treated with 10 wt% of BPO with 0.5 ml of APTES. The suspension was heated at 110 ^{0}C under reflux with continuous stirred for 8hrs. APTES modified MWCNT (OSi-MWCNT) was then filtered and washed with toluene and acetone several times before drying at 80 ^{0}C for 8 hrs in vacuum oven.

Radical-Silanization

0.5 g MWCNT was treated with 10 wt% of BPO with 0.5 ml APTES directly in 50 ml toluene. The suspension was heated at 110 ^{0}C under reflux with continuous stirred for 8 hrs. Radical-silanized MWCNT (Si-MWCNT) was then filtered and washed with toluene and acetone several times before drying at 80 ^{0}C for 8 hrs in vacuum oven.

Samples Characterization

The chemical surface of unmodified-MWCNT (u-MWCNT), Osi-MWCNT and Si-MWCNT were evaluated through Fourier Transform Infrared (FTIR) spectra using Perkin Elmer, Spectrum One FTIR Spectrometer with KBr pellets. At least 32 scans as signal-averaged with a resolution of 2 cm^{-1} in the range 4000 to 400 cm^{-1} was done. The degree of functionalization or defect was evaluated by Raman spectra and more accurately by Thermalgravimetric Analysis (TGA). The Raman spectrum of samples were obtained using Jobin Yvon Horiba spectrometer. Argon ion laser at an excitation wavelength 514.5 nm in back scattering configuration with laser power of about 20 mW at sample surface was used. TGA was conducted in nitrogen atmosphere with heating rate 20 ^{0}C/min with Perkin Elmer Pyris Diamond TG/DTG from room temperature to 900 ^{0}C. The morphology of MWCNT was observed through Transmission Electron Microscopy (TEM, Philips CM12) with 120 kV accelerating voltage.

RESULTS AND DISCUSSIONS

Surface Functionalities on the Silanized-MWCNT

FTIR measurement are commonly performed in order to differentiate chemically the surface of MWCNT before and after the treatment based on the presence of the vibration of functional groups attached on the nanotubes surface. Figure 1 clearly shows the alteration vibational responses of u-MWCNT after oxidation, oxidation-silanization and radical-silanization treatment. As indicated, it can be seen that after the oxidation treatment the absorption band of C=C has shifted to the higher frequency from 1570 cm^{-1} to 1580 cm^{-1} and new band of C-C at 1166 cm^{-1} has appeared. The bands could be assigned to the vibration of carbon skeletal due to the introduction of defect on the geometry structure of MWCNT [15-18]. However it was found that the intensities of C=C band decreased in the silanized samples (OSi-MWCNT and Si-MWCNT), suggesting aminosilane has been covalently grafted on the nanotubes. Besides that, an absorption peak at 1740 cm^{-1} due to the C=O vibration [18, 19], strengthened with the presence of C-OH bending at ~1430 cm^{-1} [20, 21] and C-O stretching mode at 1106 cm^{-1} and 1050 cm^{-1} [22] which clearly demonstrated the presence of -COOH functional groups on the O-MWCNT surface.

Additionally, the appearance of peak at broad band ~1100 - 1020cm^{-1} attributed to the presence of silanol groups (-Si-O-), siloxane linkage (-Si-O-Si-) or interaction of aminosilane molecule with MWCNT surface (-Si-O-C-) on the OSi-MWCNT and Si-MWCNT samples [23, 24] Moreover, the absorption peak at ~1444cm^{-1} and ~1630cm^{-1} respectively refer to the CH_2 bending vibration and NH deformation of APTES [14].

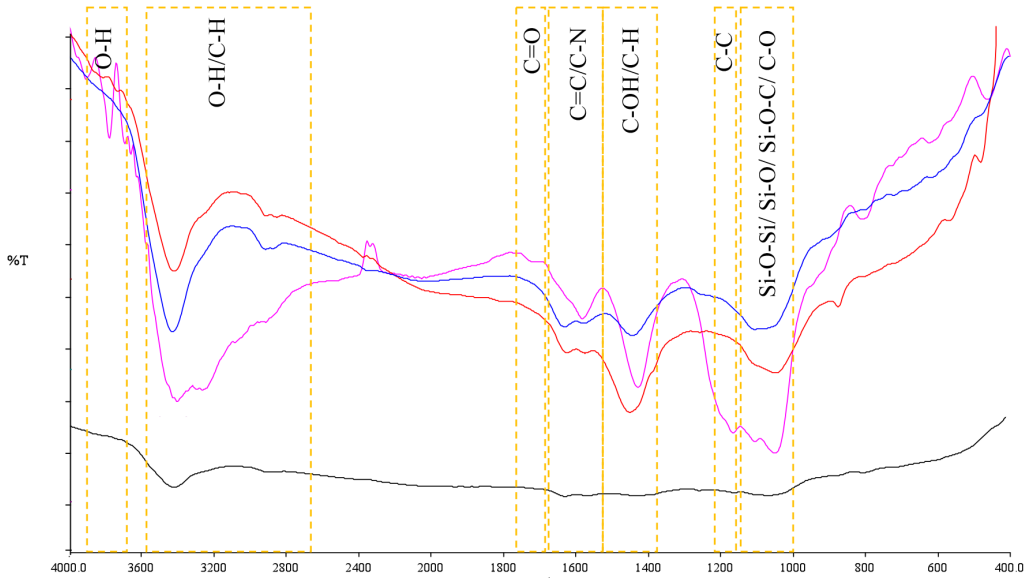

Figure 1: FTIR spectra of (a)---uMWCNT, (b)---O4-MWCNT, (c)---O4Si-MWCNT and (d)---InSi-MWCNT

The Degree of Silanization Treatment on MWCNT

The Raman spectra of u-MWCNT, O-MWCNT, OSi-MWCNT and Si-MWCNT are shown in Figure 2. The Raman spectrum displays two main peaks; D-band and G-band representing as disordered graphite structure and vibration of sp^2 carbon materials, respectively. For further

evidence on the alteration of MWCNT structure due to the defect formation or the degree of functional groups attaching on the tubes surface can be estimated via calculation of the I_D/I_G ratio [25]. From Figure 2, after the treatment the I_D/I_G ratio has increase from 0.8336 cm^{-1} to the 0.9412 cm^{-1}, 0.9536 cm^{-1} and 1.060 $cm^{-1}$for u-MWCNT, O-MWCNT, OSi-MWCNT and Si-MWCNT, respectively.

Apart of the defect formation on the MWCNT structure, the enhancement of I_D/I_G ratio probably contributed by the degrees of functionalization on MWCNT. If refer to the degrees of functionalization, the enhancement of I_D/I_G ratio, can be due to more functional groups attaching on the surface of MWCNT which consequently causes disorder on the structure of MWCNT [10, 25]. The disruption on the π-system of MWCNT was due to the many presence sp^3 state of carbons (single bond linkage) detected compare to the existence of sp^2 carbon network of MWCNT. Therefore the intensity of G-band of radical-silanization drop off slightly corresponds to the presence of covalent functionalization of functional groups, whereas the intensity of D-band increased with the contribution from disorder on the graphitic structure.

The difference in I_D/I_G ratio between OSi-MWCNT and Si-MWCNT is due to higher degree of functionalization onto the MWCNT surface. As it is known, oxidation treatment led to creation of new defect sites and the attachment of carboxyl and hydroxyl group, as anchoring point for aminosilane molecule during the next silanization treatment [25]. Therefore, the slightly enhancement of I_D/I_G ratio after oxidation-silanization treatment depict less of aminosilane molecule attaching on the MWCNT surface.

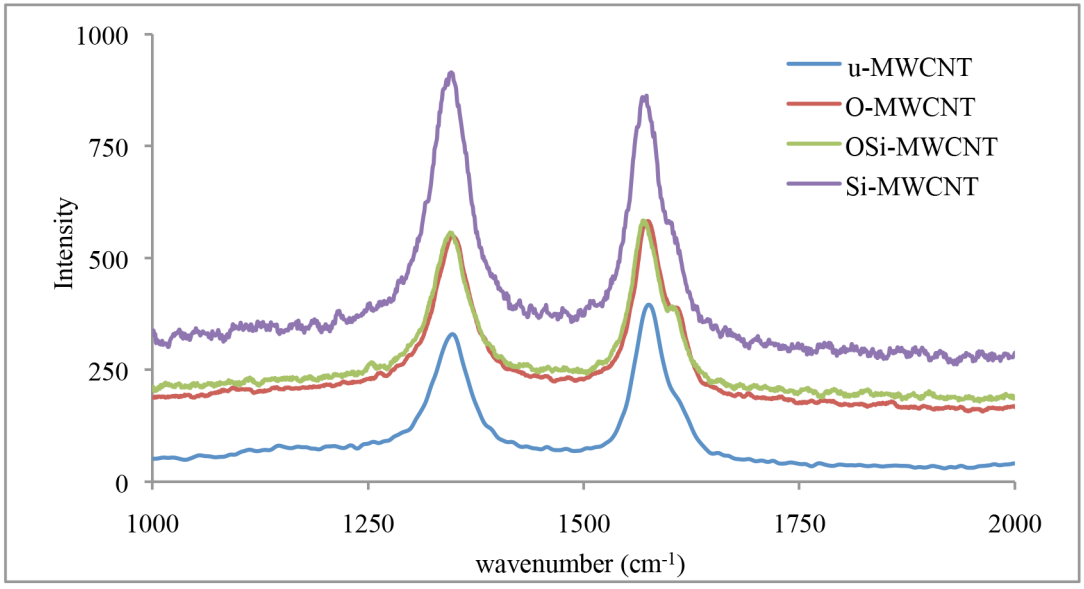

Figure 2: The Raman spectra of u-MWCNT, O-MWCNT, OSi-MWCNT and Si-MWCNT

Further study of the content of the functionalized MWCNT was done by TGA and DTG and the curves are shown in Figure 3. For u-MWCNT (Fig. 3a) graphitized structure undergoes combustion after exposed to higher temperature around ~840 ^{0}C with approximately 2 wt% of weight loss during degradation process. This weight loss was due to the degradation of amorphous carbonaceous materials at low temperature <500 ^{0}C. Likewise the presence of organic substances

attached on MWCNT surface were degraded between the low temperature < 300 ^{0}C to the high temperature (typically ~500 ^{0}C) [26-29]. Degradation at low temperature (<500 ^{0}C) may be due to the low activation energies to oxidize or probably due to the presence of large number of active site [28].

Treatments on nanotubes that allow the attachment of organic functional groups or introducing defect sites tend to decrease thermal stability of nanotubes. It can be seen that thermal decomposition of nanotube has been found to shift to lower temperature. O-MWCNT (Fig. 3b) shows the disordered structure of nanotubes undergoes combustion at lower temperature after 600 ^{0}C heating compare with u-MWCNT. This was due to the presence of carboxylic and hydroxyl groups functionalized MWCNT. Found that ~5.2 wt% of weight loss due to decarboxylation of carboxylic and elimination of hydroxyl functional groups during thermal degradation in the range between 150 ^{0}C and 525 ^{0}C. Instead the initial stage decomposition <150 ^{0}C was attributed to the moisture desorption (2.8 wt%) [28].

The presence of aminosilane attached to the nanotube cause several stages of degradation steps. Initial combustion near ~200 ^{0}C, estimated to be about ~2 wt% of weight loss on both silanized-MWCNT samples (OSi-MWCNT (Fig. 3c) and SI-MWCNT (Fig. 3d)). This weight loss can be assigned to evaporation of moisture with simultaneous condensation of outermost layer of aminosilane which are physically attached on the MWCNT surface. On the further heating, the weight loss of O-MWCNT at 500 ^{0}C, 10.8 wt% of weight loss was detected for OSi-MWCNT. This decomposition may be attributed to the decarboxylation of carboxylic and elimination of hydroxyl functional groups. This probably overlap with condensation of aminosilane that is weakly bonded to the nanotubes surface. A sharp DTG curve of OSi-MWCNT at 615 ^{0}C may be due to the simultaneous thermal decomposition of aminosilane with the combustion on disordered carbon of MWCNT [30, 31]

However Si-MWCNT (Fig. 3d) displays a different decomposition behavior when heating until 750 ^{0}C. DTG curve depicted two stages of thermal degradation behavior. At low temperature in range of 170 ^{0}C to 320 ^{0}C indicated ~2.2 wt% of weight loss correspond to combustion of phenyl and benzoate groups together with condensation of outermost layer of aminosilane or partially multilayer APTES that weakly bond to MWCNT. Approximately the weight loss of 12.8 wt% occurs between 320 ^{0}C to 750 ^{0}C can be attributed to degradation of aminosilane molecule that covalently grafted on the MWCNT [25]. The degradation of the remaining Si-MWCNT which occur at higher temperature over 750 ^{0}C, indicated that radical-silanization has preserve graphitic structure of the nanotubes having less number of defects during the treatment which then provide better thermal stability than sample treated by oxidation-silanization.

Surface Morphology of Treated-MWCNT

Finally to evaluate the possible degradation due to the oxidation and radical treatment on MWCNT, Figure 4 shows TEM images of u-MWCNT (Fig.4a), O-MWCNT (Fig. 4b), OSi-MWCNT (Fig. 4c) and Si-MWCNT (Fig. 4d). The red arrow clearly shows the image of MWCNT end cap. Partially end-cap of MWCNT was broken (purple arrow) after both treatments; oxidation and radical treatment or probably due to the effect of cutting on the tube and produce a tubes shorter than the original length.

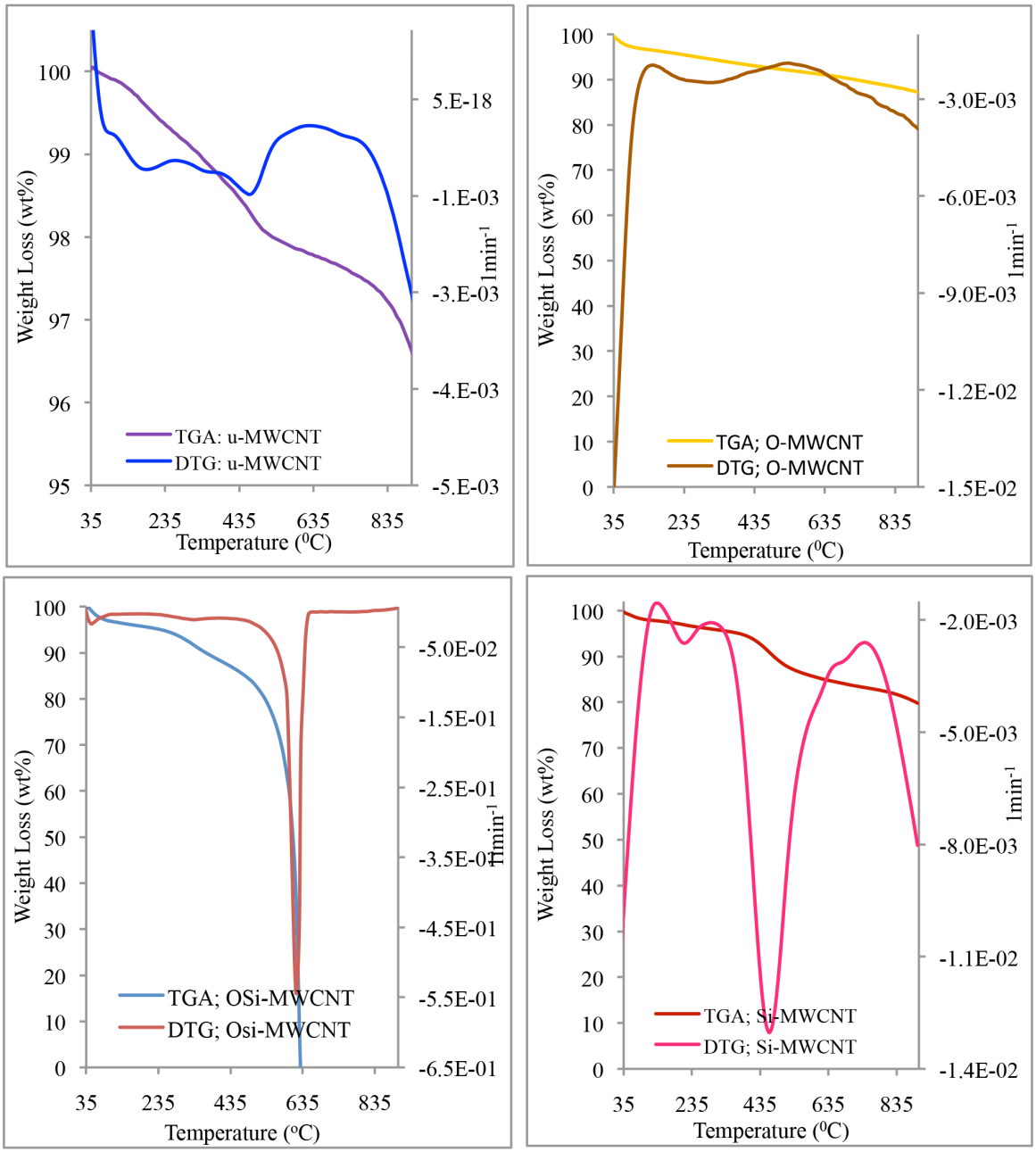

Figure 3: TGA and DTG results for (a) u-MWCNT, (b) O-MWCNT, (c) OSi-MWCNT and (d) Si-MWCNT

The attachment of aminosilane layer on the surface of MWCNT can be illustrated by TEM observation. It can be seen as indicated by the green arrow (OSi-MWCNT; Fig. 4c and Si-MWCNT; Fig. 4d), the outer surface of MWCNT becomes rough after silanization. These rough surfaces on the tubes were due to the attachment of aminosilane molecules. The multilayer of aminosilane tends to be grafted at the end-cap of tube and form slightly like "chemical bridge" connecting each tubes. The connection was form through the bonding of siloxane linkage (Si-O-Si). This observation is confirmed by the of FTIR results discussed earlier.

CONCLUSION

Functionalization of MWCNT with aminosilane molecule has been conducted through the treatment of oxidation-silanization and radical-silanization. All analysis reveals, aminosilane molecules have been successfully attached covalently to the end-cap and the sidewalls of the MWCNT. The density of aminosilane attached to the tubes strongly depended on the manner of treatment. Interestingly this new approach of radical-silanization treatment tends to creates less number of defects besides allowing covalent attachment of aminosilane molecule.

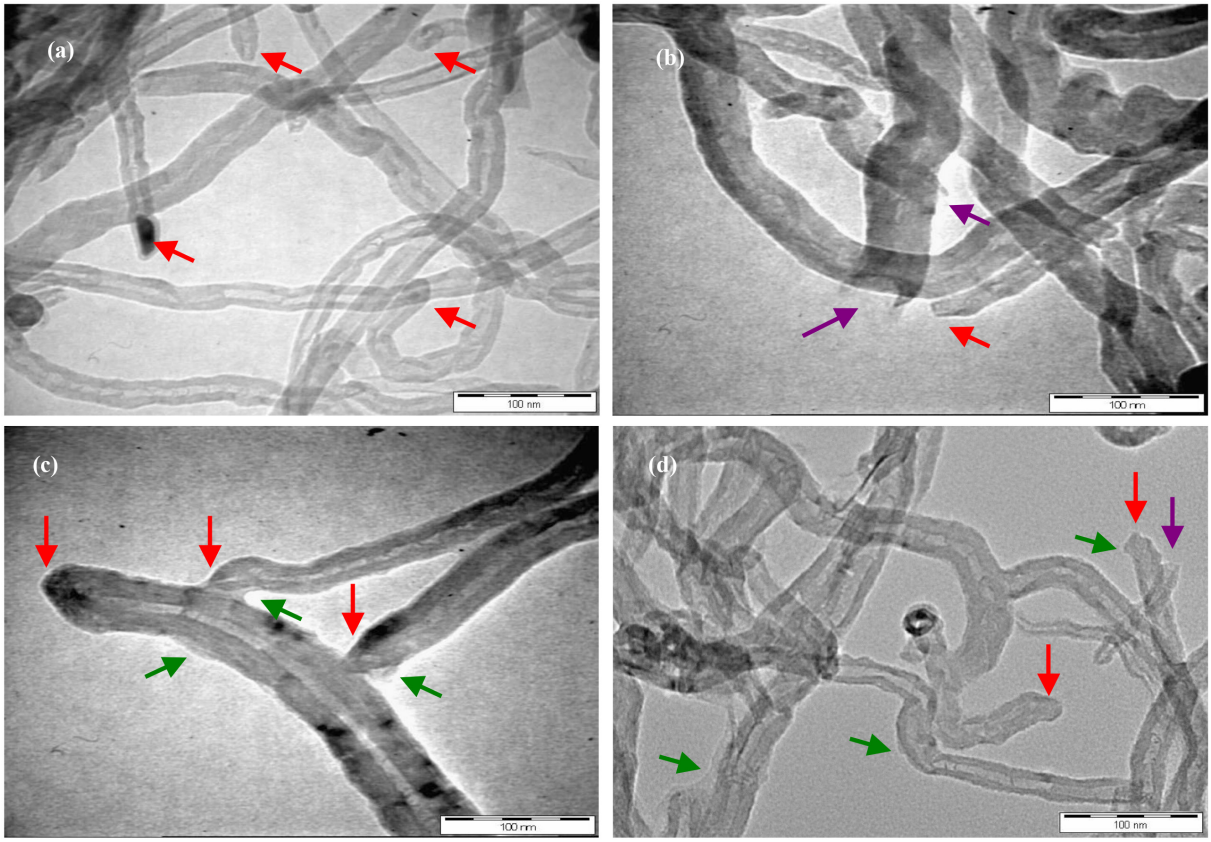

Figure 4: Surface morphology of (a) u-MWCNT, (b) O-MWCNT, (c) OSi-MWCNT and (d) Si-MWCNT

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Junidah Abdul Shukor
School of Materials and Mineral Resources Engineering
Universiti Sains Malaysia, 14300 Nibong Tebal, Penang, Malaysia
junidah0602@gmail.com

Azizan Aziz
School of Materials and Mineral Resources Engineering
Universiti Sains Malaysia, 14300 Nibong Tebal, Penang, Malaysia
azizan@eng.usm.my

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Comparative Studies of Ground Level Ozone Concentration in East and West Coast Peninsular Malaysia

Norrimi Rosaida Awang, Nor Azam Ramli & Ahmad Shukri Yahaya

ABSTRACT

A comparative study of ground level ozone concentration in east and west (central) coast of Peninsular Malaysia was presented. Ground level ozone was noted as one of the significant air pollution issue worldwide due to the increase of anthropogenic emissions of ozone precursors such as oxides of nitrogen and volatile organic compounds. Kemaman, Terengganu and Shah Alam, Selangor were selected to represent east coast and west coast respectively. Similar diurnal pattern with different magnitude was found in both coastal. Ozone concentration was at the peak in Shah Alam at 3.00 pm while in Kemaman it was an hour earlier. However, both coastal recorded minimum concentrations at around 8.00 a.m. throughout the year 2008. A larger diurnal amplitudes of up to 73 ppb were also recorded in Shah Alam. From the assessment of daytime and night time ozone concentrations, a higher night time concentration was recorded in Kemaman which was at around 20 ppb compared to Shah Alam which was only at about 5 ppb. Kemaman also seems to be producing a higher variation according to the monsoonal changes while Shah Alam showed more uniform ozone concentration and less affected by monsoonal changes but relatively higher hourly maximum concentration. Comparatively, west coast showed more serious ozone pollution than east coast. 77 "exceedences" were measured in Shah Alam compared to zero in Kemaman.

Keywords: surface ozone, NO_x, Kemaman, Shah Alam, diurnal, ozone fluctuations

ABSTRAK

Kajian perbandingan antara kepekatan ozon di pantai timur dan barat (tengah) Semenanjung Malaysia telah dijalankan. Ozon permukaan bumi merupakan salah satu masalah pencemar udara yang penting di seluruh dunia kerana peningkatan pengeluaran prapenanda ozon seperti nitrogen oksida dan campuran bahan organik terampai oleh kegiatan manusia. Kemaman yang terletak di negeri Terengganu dan Shah Alam yang terletak di negeri Selangor telah dipilih untuk mewakili Pantai Timur dan Pantai Barat di dalam kajian. Corak harian yang hampir sama dengan magnitud yang berbeza telah ditemui di kedua-dua pantai. Kemuncak kepekatan ozon telah diacapai pada pukul 3.00 petang di Shah Alam, manakala kemuncak kepekatan di Kemaman dicatatkan sejam lebih awal berbanding Shah Alam. Walaubagaimanapun, kedua-dua pantai mencapai kepekatan minimal pada masa yang sama iaitu jam 8.00 pagi sepanjang tahun 2008. Amplitude harian yang lebih besar yang mencapai 73 ppb juga telah dicatatkan di Shah Alam. Menurut penilaian terhadap kepekatan ozon pada waktu siang dan malam, kepekatan ozon di waktu malam di Kemaman adalah lebih tinggi (20 ppb) berbanding Shah Alam (5 ppb). Kepekatan ozon di Kemaman juga didapati berubah dengan lebih nyata mengikut perubahan monsun. Sementara itu, Shah Alam menunjukkan kepekatan yang lebih seragam dan kurang dipengaruhi oleh perubahan monsun tetapi dengan kepekatan sejam yang lebih tinggi. Secara perbandingan, Pantai Barat didapati mengalami masalah pencemaran ozon yang

lebit teruk daripada Pantai Timur. 77 kali kejadian kepekatan ozon melepasi garis panduan telah dicatatkan di Shah Alam, manakala tiada kejadian telah dicatatkan di Kemaman.

Kata kunci: ozon permukaan, NOx, Kemaman, Shah Alam, ozon harian, turun naik ozon

INTRODUCTION

Most of the world population recognized ozone as the substance that occur in stratosphere layer that absorbs the majority of ultraviolet rays with wavelengths less than 280 nm from entering the earth's atmosphere (Reddy et al., 2011). The stratospheric ozone works as a shield to protect the earth from the harmful rays. However, ozone became a hazardous substance when it was found on the ground level or earth surface. In recent years, ozone was classified as one of the major air pollutants which were associated with deteriorating human health. According to Abdul-Wahab et al. (2005), ground level ozone had been considered as the principal constituents of the photochemical smog.

Ground level ozone was a unique pollutant that was produced by the photochemical reactions of ozone precursors with the presence of the UV lights. Unlike, primary air pollutants such as particulate matter with aerodynamic diameter less than 10 micrometer (PM_{10}), carbon monoxide (CO), oxides of nitrogen (NO_x), and sulphur dioxide (SO_2), there was no significant source of the ground level ozone (Abdul-Wahab et al., 2005). Normally, ozone precursors comprised of primary air pollutants such as oxides of nitrogen, sulphur oxides, carbon oxides, and volatile organic compounds (Gvozdic et al., 2010). The sensitivity of ozone concentration in the atmosphere was greatly influenced by the anthropogenic emissions which was a main source of ozone precursors. Placet et al. (2000) categorized the ozone precursor sources in inventories of natural sources (i.e. vegetation), mobile sources (i.e. motor vehicle), and stationary sources (i.e. power plants, industrial facilities, residential and commercial establishments). In addition, ozone concentration was very responsive towards meteorological parameters such as temperature, UV lights, wind speed, and relative humidity (Gvozdic et al., 2011; Reddy et al., 2011), which caused the variation in ozone concentration.

Over the last decade, ozone received intensive attention from around the world, owing to its capability and role in damaging plant species, various natural materials and manufactured goods as well as human lung tissues (Abdul-Wahab et al., 2005). Reduction in ozone concentration became the objective and challenge to the air quality policy of many governments. This was due to the prevailing sources of ozone precursors that were mostly produced by anthropogenic activities. Due to rapid economic and industrial growth, Malaysia also faced the ozone issue. In Malaysia, it was known as a significant air pollution which was included in Malaysia Ambient Air Quality Guidelines (MAAQG) produced by Department of Environment, Malaysia. The critical limit of ambient ozone concentration was set at 100 ppb (DoE, 2010). However, studies focusing on ozone concentration in Malaysian conditions were limited and inadequate. In recent years, studies conducted by Ghazali et al. (2010) concluded that ozone concentrations were negatively corresponded to NO_2 which was the main ozone precursors. Meanwhile, Mohammed et al. (2013) mentioned that increased in ozone concentration during the off-season of paddy planting tropical region significantly affect the paddy reduction. Latif et al. (2012) mentioned that ozone concentration in Klang Valley urban areas needed intensive monitoring since numbers of

exceedences of MAAQG were increasing. The deficient proves to establish a relationship between ozone and non methane hydrocarbons (NMHCs) and carbon monoxides (CO).

Ozone exhibited strong temporal variations depending on the precursors and climatic condition. In most of the seasonal countries, the peak concentrations were found during summer while the minimum concentrations were in winter. (Duenas et al., 2004; Esen et al., 2005; Reddy et al., 2011). Unlike seasonal countries, Malaysia experienced continuous uniformed temperature and high humidity with the seasons been distinguished by monsoonal changes (Md Yusof et al., 2010). According to Malaysia Meteorological Department, there were four monsoonal seasons experienced in Malaysia which were known as north east monsoon (November to March), first transitional period (April to May), south west monsoon (June to September) and second transitional period (October to November). These monsoonal changes also caused a slight difference in climatic conditions between the east and west coast of Peninsular Malaysia. Since the formation of ozone was dependence to its customary factors such as ozone precursors and UV lights, the ozone concentration was expected to be different in both coastal. In the present paper, a comparative study between east and north ozone concentration was presented. The variability of the ozone concentration in both locations in terms of diurnal, daytime and night time and monsoonal differences was presented.

MEASUREMENT SITES, METEOROLOGY AND EXPERIMENTAL TECHNIQUE

The measurements of ozone concentration were carried out simultaneously at Kemaman [N04°16.260, E103°25.826] which was located at east coast of Peninsular Malaysia and at Shah Alam [N03°04.636, E101°30.673], an urban areas that were located in west coast of Peninsular Malaysia. The monitoring was carried out for a period of one year during 2008 starting from first January until 31st December on an hourly basis.

Kemaman was one of the district in Terengganu state with an area of 2535 km^2 or 19.57 % of the total area of Terengganu (Toriman et al., 2009). According to Sulong et al. (2002), Kemaman was relatively under developed except for a few places along the coastline where steel and petrochemical plants were situated. The two main industrial sites that were governing the economy of Kemaman were Kerteh Petrochemical Industrial Area and Gebeng Industrial Area (Ismail et al., 2011). Climatically, Kemaman experienced wet equatorial climate which characterized by high temperature with seasonally heavy rains during north east monsoon (November to January) (Sulong et al., 2002). According Meteorological Department, annual rainfall in Kemaman was around 239 mm, with an average temperature of 27^{o}C (maximum 31^{o}C; minimum 22^{o}C). Uniform relative humidity of 81 % was also recorded all year round (Toriman et al., 2009).

Shah Alam the capital city of Selangor was located about 25 km to the west of Malaysia capital, city of Kuala Lumpur (Ghazali et al 2010). It was the first Malaysian planned city which covered an area of 290.3 km^2 and divided into 56 sections. Shah Alam monitoring station was located at residential areas within the vicinity of a few industrial areas (Azmi et al., 2010; Ghazali et al., 2010). There were six major highways governing the transportation system in Shah Alam. Azmi et al. (2010) mentioned that the highways and major roads in Shah Alam showed significant traffic density especially during morning and late evening rush hours. According to Abdullah

et al. (2011), high population and traffic density in Shah Alam accompanied by weak prevailing wind may cause stagnation in air pollution in that area. Climatically, Shah Alam experienced the same tropical rainforest climate with the warmest temperature in March. Heavy rains were expected during November due to north east monsoon.

Continuous hourly ozone concentration in both east and west coast Peninsular Malaysia were measured using UV Absorption Ozone Analyzer Model 400A. The device was a microprocessor controlled analyzer (Mohammed et al., 2013), which applied a system based on the Beer-Lambert law in order to measure law ranges of ozone, the ambient air or gaseous media (Ghazali et al., 2010). According to the Teledyne (1999), ambient ozone molecule was detected based on an internal electronic resonance of ozone molecule using absorption of 254 nm UV light that was emitted from internal mercury lamp.

RESULT AND DISCUSSION

Ozone variation on diurnal scale

Diurnal variation had the biggest influence towards ozone formation in the atmosphere. Since ozone was a secondary air pollutant that was formed in the atmosphere from photochemical reaction of ozone precursors and UV radiation, significant diurnal changes were observed. Unlike the ozone formation reactions that had occurred in stratosphere layer, ozone formation in ground level required ozone precursors in order to complete the process. The main precursor reported by various studies was NO_x (Reddy et al., 2011; Duenas et al., 2004; Latif et al., 2012; Mohammed et al., 2013), which mostly produced by anthropogenic activities. Seinfeld and Pandis (2006) listed three most important reactions in producing ground level ozone in equation 1 to equation 3.

$$NO_2 + hv \xrightarrow{\lambda \leq 430\ nm} NO + O \quad (1)$$

$$O + O_2 + M \rightarrow O_3 + M \quad (2)$$

$$O_3 + NO \rightarrow NO_2 + O_2 \quad (3)$$

Diurnal cycles of hourly mean of ozone concentration in Kemaman and Shah Alam during 2008 were depicted in Figure 1. The figures suggested that ozone concentration in both coastal showed similar trends with different magnitudes where daytime ozone concentration was noticeably higher that night time concentration. Figure 1 depicted that, ozone concentration slowly decreased during night time (1.00 am to 7.00 am) before reaching the minimum concentration at 8.00 am due to the chemical loss by NO titration and deposition processes (Reddy et al., 2011). The concentration started to increase and reached the maximum concentration, recorded at 2.00 pm and 3.00 pm in Kemaman and Shah Alam respectively. Once reached the peak concentration, ozone started to decrease steadily throughout the remaining hours. The same diurnal pattern also reported by Reddy et al. (2011) which study the ozone concentration in Southern Asia areas and Duenas et al. (2004), that described the ozone concentration in urban and rural sites in Spain. The result in both coastal suggested that diurnal ozone variation followed the intensity of the UV radiation. UV radiation acted as photochemical catalyst in equation 1 that breaks NO_2 molecule into NO and atom oxygen (Seinfeld and Pandis, 2006). In the morning, ozone concentration increased with the increased of NO_2 concentrations that were attributed by traffic emission

which also promoted NO_2 photolysis (equation 1) (Ghazali et al., 2010). However, reactions between ozone and NO that would produce NO_2 was the main removal mechanism of ozone in the atmosphere (Lazaridis, 2011).

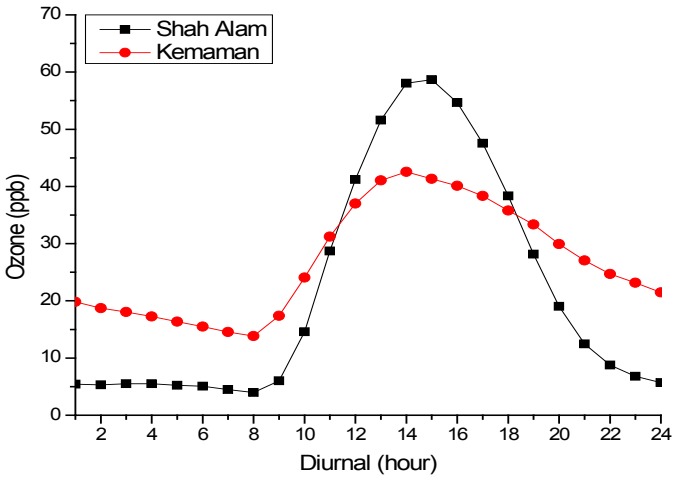

Figure 1: Diurnal cycle of hourly mean ozone concentration during 2008 measured at Kemaman and Shah Alam

Since variation of ozone reported to be depending on meteorological parameters, further investigation with different climatic conditions was inquired. Detailed statistics of monthly mean, diurnally maximum and minimum concentration with their occurrence time as well as the diurnal amplitude were summarized in Table 1. Result suggested that the mean of ozone concentration in Kemaman which was in the range of 14.98 to 40.60 ppb was higher than the mean concentration recorded in Shah Alam which was in the range of 19.28 to 26.42 ppb. Nevertheless, the highest mean was recorded in February for both coastal. Noticeably in Kemaman, the maximum diurnal concentrations were at 2.00pm throughout 2008 except for January and November. Meanwhile, the minimum concentrations occurred at 8.00 am except for April and May 2008. Conversely, Shah Alam did not show similar trend, where the maximum concentration recorded was from 1.00pm to 4.00 pm. Most of the monthly minimum concentrations in Shah Alam measured, was at 8.00 am except for in April and December which surprisingly occurred at midnight, while in May at 7.00 am. Diurnal monthly amplitude ozone concentration suggested that Shah Alam showed higher amplitude which indicated that the differences between maximum and minimum concentrations were larger as compared to Kemaman.

Monthly variations of ground level ozone concentrations on a diurnal scale at east and west coast Peninsular Malaysia depicted in Figure 2, clearly showed significant differences between monthly variations between the two coastal. Figures revealed that in Shah Alam, highest concentration observed was during February to May (66.45 to 75.80 ppb) with uniform concentration during night time (1 to 10.00 ppb). On the contrary, Kemaman, recorded highest concentration during May to July in 2008 with the lowest concentration occurred during November to December. Great variations were recorded during night time at east coast compared to west coast.

Table 1: Statistics of O_3 monthly mean, diurnal maximum concentration and time occurrence, diurnal minimum concentration and time occurrence, and diurnal amplitude

Month	Kemaman (East Coast)				Shah Alam (West Coast)			
	Mean	Diurnal Max	Diurnal Min	Diurnal	Mean	Diurnal Max	Diurnal Min	Diurnal
	ppb	ppb (time)	ppb (time)	Amplitude	ppb	ppb (time)	ppb (time)	Amplitude
Jan	39.92	49.10 (13:00)	32.06 (8:00)	17.03	24.12	74.83 (15:00)	3.13 (8:00)	71.70
Feb	40.60	52.45 (14:00)	28.03 (8:00)	24.42	26.42	75.70 (16:00)	2.32 (8:00)	73.38
Mar	24.77	32.36 (14:00)	17.80 (8.00)	14.55	23.23	67.77 (14:00)	3.10 (8:00)	64.67
Apr	26.11	45.72 (14:00)	13.14 (7:00)	32.58	22.20	69.10 (14:00)	4.20 (24:00)	64.90
May	38.22	59.03(14:00)	20.10 (7:00)	38.93	22.12	58.28 (15:00)	4.18 (7:00)	54.10
Jun	32.94	55.04 (14:00)	15.87 (8:00)	39.17	19.28	54.04 (14:00)	3.80 (8:00)	50.23
Jul	23.93	41.75 (14:00)	7.53 (8:00)	34.23	17.70	47.65 (16:00)	3.26 (8:00)	44.39
Aug	22.14	42.16 (14:00)	5.43 (8:00)	36.73	20.36	55.41 (15:00)	3.82 (8:00)	51.59
Sep	22.77	43.96 (14:00)	4.03 (8:00)	39.93	18.84	47.64 (14:00)	3.75 (8:00)	43.88
Oct	14.98	32.89(14:00)	3.20 (8:00)	29.69	23.04	57.32 (13:00)	5.20 (8:00)	52.11
Nov	15.42	29.25 (15:00)	5.79 (8:00)	23.46	20.10	55.82 (15:00)	3.78 (8:00)	52.04
Dec	19.49	29.10 (14:00)	11.73 (8:00)	17.37	22.99	62.72 (15:00)	4.7 (1:00)	58.02

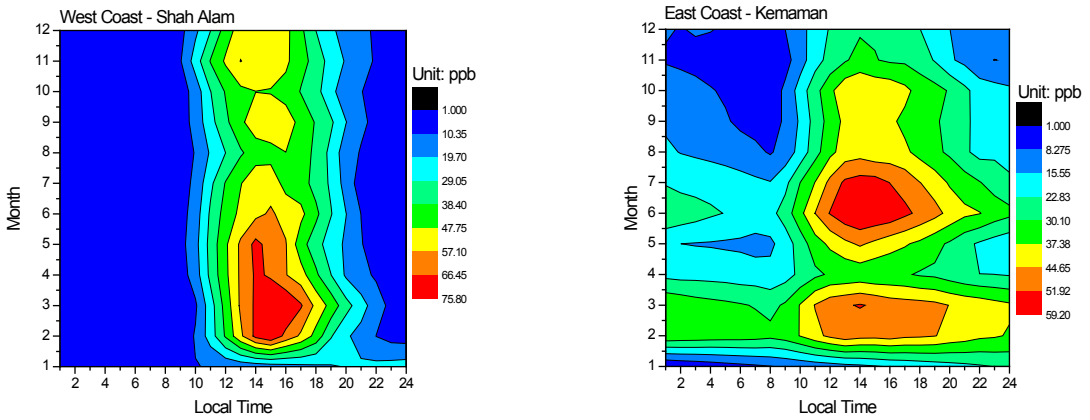

Figure 2: Monthly variations of ground level ozone concentration on a diurnal scale at east and west coast Peninsular Malaysia

Daytime and nighttime variations

Since UV light played an important role in ozone formations, the variations between day time and night time were expected to occur in ozone concentrations. Spatial mapping of ground level O_3 concentration in Malaysia during: (a) day time; (b) night time showed in Figure 3, with great differences was recorded and together with the detailed statistics depicted using box and whisker plot in Figure 4 and monthly comparison summarized in Figure 5. As mentioned in the section before, the day time ozone concentrations was much higher that night time aided by the availability of the UV light (Reddy et al., 2011; Azmi et al., 2010; Ghazali et al., 2010) which promotes the ozone formation. The differences could be observed using the spatial mapping of ozone concentration across Malaysia in Figure 3, where distinctive differences could be concluded.

In contradiction to the statement, Kemaman produced high ozone during night time which on average about 20 ppb, which was about 10 ppb differences with daytime ozone concentration. However, in Shah Alam only a small concentration was recorded during night time and higher ozone concentration was shown during daytime. Since it was impossible for ozone to form without UV light during night time higher ozone concentration recorded in Kemaman was most probably due to low deposition rate that cause ozone to be retained in the atmosphere longer or transboundary pollution effect. Based on Figure 5, both coastal stations showed great variations of ozone concentration throughout the year. It was observed that in most of the months, Shah Alam showed a higher concentration during day time while Kemaman recorded higher concentration during night time.

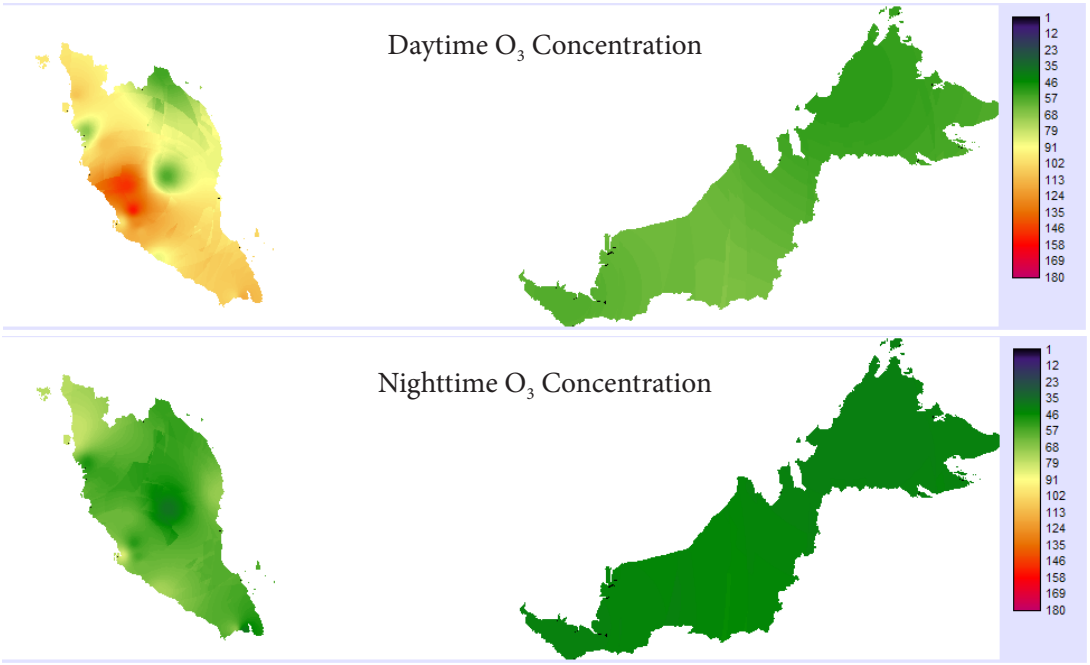

Figure 3: Spatial mapping of ground level O_3 concentration in Malaysia during: (a) daytime; (b) nighttime

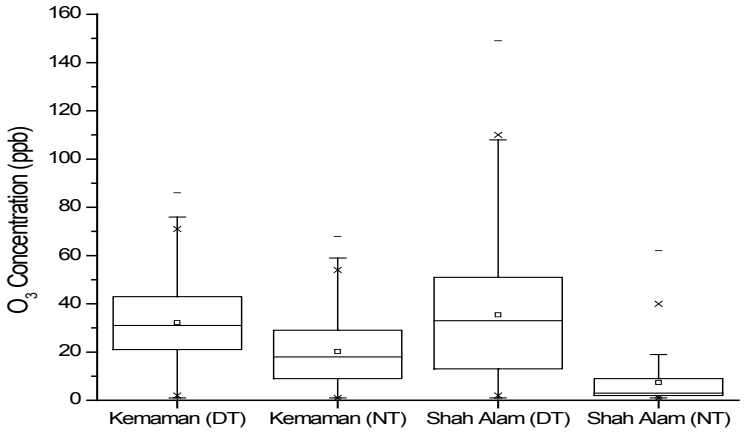

Figure 4: Box and whisker plot of hourly ozone concentration during daytime and nighttime

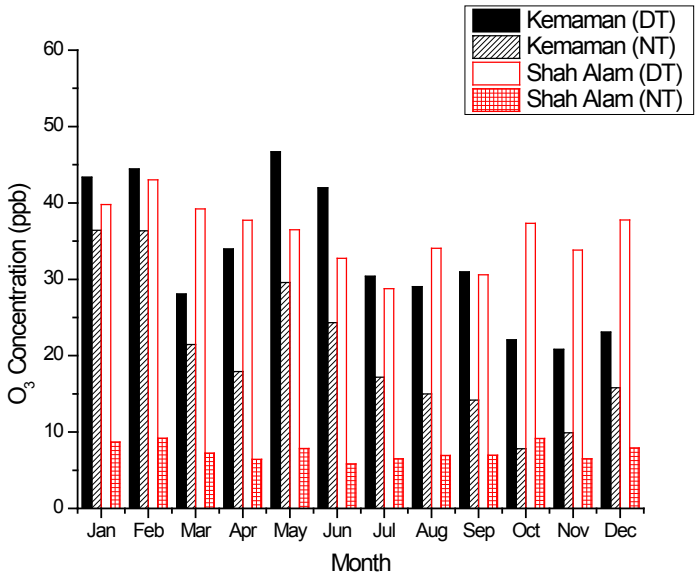

Figure 5: Monthly average ozone concentrations in Kemaman and Shah Alam

Monsoonal Differences between east coast and west coast

According to Md Yusof et al. (2010), seasonal variations in Malaysia were distinguished by the changes in wind flow patterns and rainfall intensity. Some uniform periodic changes in wind flow and the rainfall intensity were recorded and explained as monsoonal changes. There were two prominent monsoonal seasons in Malaysia, north east monsoon and south west monsoon with two transitional periods (MMD, 2013). The daily average of hourly ozone concentration in east and west coast during the monsoonal changes was described in Figure 6. As Kemaman showed a more uniform concentration during daytime and night time, the average concentrations were relatively higher than Shah Alam. However, Shah Alam showed more consistent hourly average during 2008 in the range of 10 to 40 ppb regarding any monsoonal changes. Less consistency was shown in Kemaman and varied according to the monsoonal changes. In early of the year, a high concentration around 50 ppb was recorded and continued to reduce in mid and end year. The lowest concentration was found during second inter monsoon (October). Higher rainfall intensity that was associated with north east monsoon which occurred during November and December promoted the wet deposition of ozone concentration, thus directly reducing the pollution concentration.

Time series plot of daily maximum of ozone concentrations in Kemaman and Shah Alam were illustrated in Figure 7. In contrary to the hourly average ozone concentration, hourly maximum time series plot showed that higher concentration was observed in Shah Alam, with 77 episodes of hourly maximum passing the critical limit of 100 ppb. Meanwhile, no exceedences were recorded in Kemaman during the period. Higher concentrations were recorded during north east monsoon and first inter monsoon compared to south west monsoon. Nevertheless the lowest maximum concentrations in Kemaman also coincided with north east monsoon during November and December. These results suggested that west coast that was represented by Shah Alam faced more severe ozone problems than east coast that was represented by Kemaman.

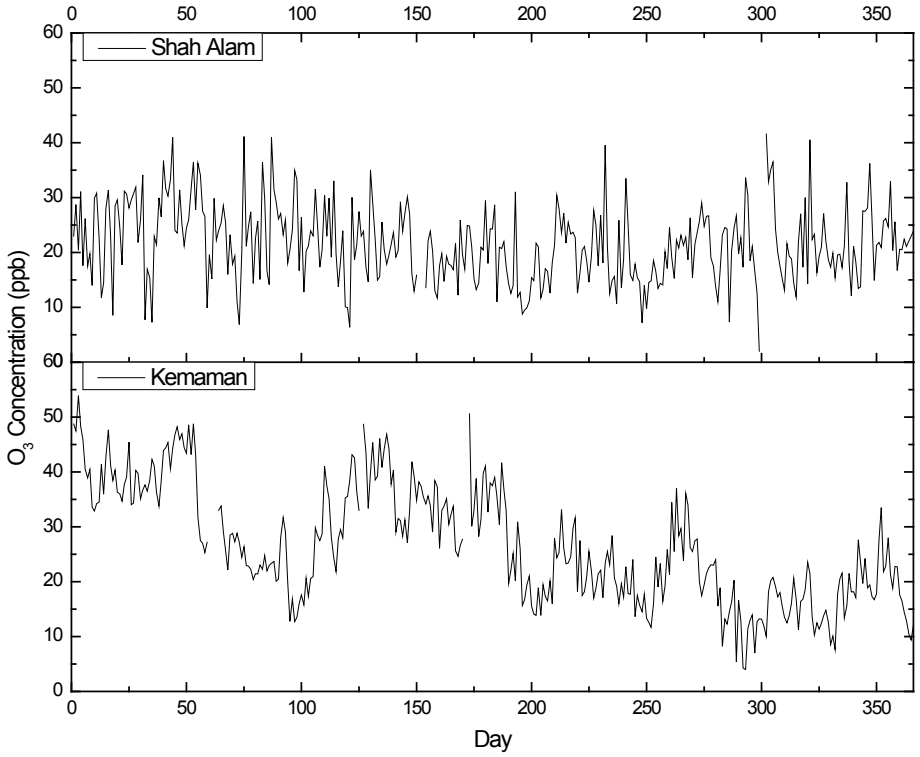

Figure 6: Daily average of O3 concentration in Kemaman and Shah Alam during monsoonal differences (a*- north east monsoon; b* - 1st inter-monsoon; c* - south west monsoon; d* - 2nd inter-monsoon; e* - north east monsoon)

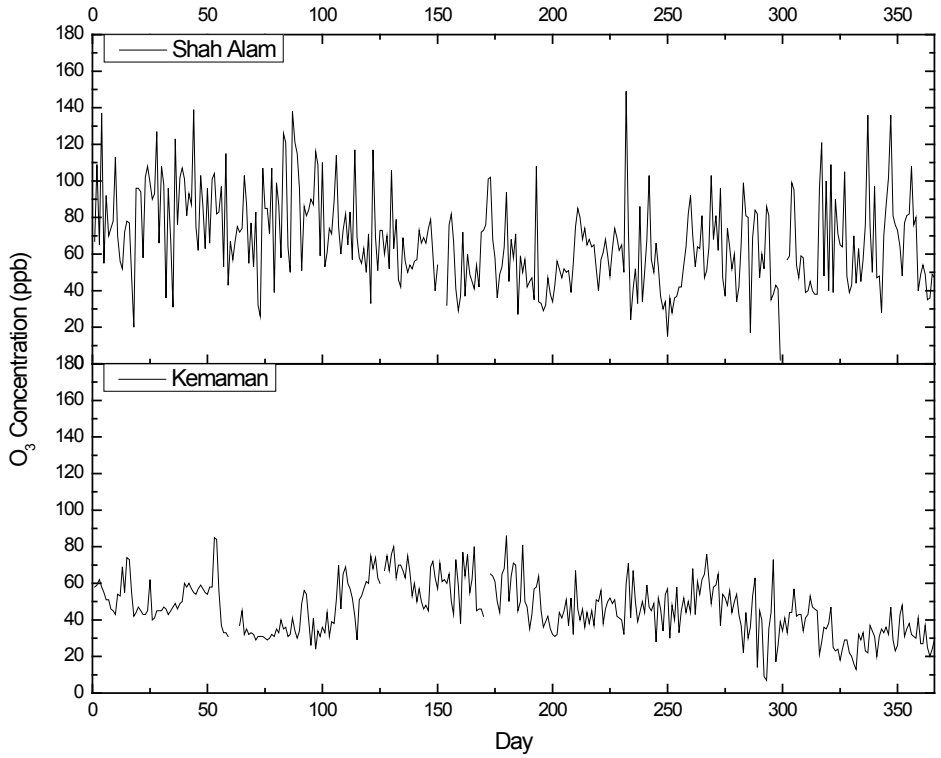

Figure 7: Daily maximun of O_3 concentration in Kemaman and Shah Alam during monsoonal differences (a*- north east monsoon; b* - 1st inter-monsoon; c* - south west monsoon; d* - 2nd inter-monsoon; e* - north east monsoon)

CONCLUSION

Significant diurnal changes were observed in east and west coast of Peninsular Malaysia. Both stations which locations were more than hundred kilometers apart in Peninsular Malaysia showed a similar pattern with different magnitude. Diurnal plots suggested that the highest concentration was observed at 2.00pm and 3.00 pm at Kemaman and Shah Alam respectively, while the lowest concentration in both coastal consistently measured at 8.00 am, which most probably attributed by NO titration. Higher diurnal amplitude was recorded in Shah Alam compared to Kemaman during most part of the year. The highest amplitude measured was in September 2008. Strong variations between daytime and night time ozone concentration were observed in Kemaman and Shah Alam. A large difference of around 40 ppb was recorded in Shah Alam, since the stations recorded high ozone concentration during daytime and very minimum concentration during night time. Uniquely, high concentration around 20 ppb was recorded during night time in Kemaman which was just about 10 ppb lower than daytime concentration. The reasons behind this scenario were less understandable since theoretically, ozone could not be formed without the existence of UV light during night time. Further investigation was required to explain the scenario, thus increased the understanding of these unique night time ozone concentrations. Results also verified that, uniform ozone concentration was observed in Shah Alam, while distinctive changes dependent on monsoonal changes was observed in Kemaman. The lowest concentration was measured in November and December which intercepted with higher rainfall intensity during north east monsoon. However, result from daily maximum time series suggested that higher concentration was recorded in Shah Alam as compared to Kemaman with 77 numbers of exceedences throughout the year, which implied that west coast Peninsular Malaysia was facing more serious ground level ozone than in west coast.

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Norrimi Rosaida Awang*
Nor Azam Ramli
Ahmad Shukri Yahaya
Clean Air Research Group
School of Civil Engineering
Engineering Campu
Universiti Sains Malaysia
14300 Nibong Tebal
Penang, MALAYSIA
**Corresponding author. Email: ceazam@eng.usm.my*
Telephone No.: + (60)4-5996227 Fax: + (60)4-5941009

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Understanding SFRA Results Using Transformer Model with Simulated Faults

Sharin Ab Ghani, Mohd Hambali Roslan, Musa Yusup Lada & Mohd Shahril Ahmad Khiar

ABSTRACT

Sweep Frequency Response Analysis (SFRA) is well known power transformer diagnostics device which capable on detected faults/changes either electrical or mechanical. However the challenges are on understanding the SFRA results for the newcomers' engineers. If wrong, mislead interpretation of SFRA results would arise. Inline of this matter, five transformers model with simulated faults have been developed. The faults are; Core Damage, Shorted Turns, Open Circuit, Radial Deformations (Hoop Buckling) and Axial Displacement. These faults are designed to imitate the actual faults occurred in power transformer. Hence, the SFRA is then applied to the models to visualize the changes of SFRA results. In fact it create a clear understanding of the SFRA results changes with referring to which faults occurred.

Index Terms— Electrical Fault, Frequency Response Analysis (FRA), Mechanical Fault, Transformer.

INTRODUCTION

Power transformer is typically designed to coherent with mechanical forces either from in service events or during transportation, such as lightning and faults [1,2]. Once the power transformer damaged, no matter it is only a small damage, it may affect the power transformer capability to withstand a short circuit fault. The mechanical force depends on the configurations of the winding [3,4]. In the transformer, it is considered to have a complex combination of RLC components. It was contributed by the resistance of the copper winding, inductance winding, and capacitance from the insulation layers between coils, winding, winding and core, core and tank, and vice versa. Fig. 1 illustrates equivalent circuit with RLC components. The basic concept of SFRA measurement is mainly come from the transfer function concept where it is based on the ratio of voltage/current output to voltage/current input. The generated signal is a sinusoidal voltage with sweeping frequency between 20 Hz and 10 MHz [5,6]. The frequency response gain from the measurement is basically representing a whole complex R-L-C network of a transformer as a Device under Test (DUT) and it will be illustrated in bode plot diagrams; consists of magnitude (dB) and phase (deg) [7,8]. Fig. 2 and 3 shows the connection setup of SFRA device and the graphical results from it respectively.

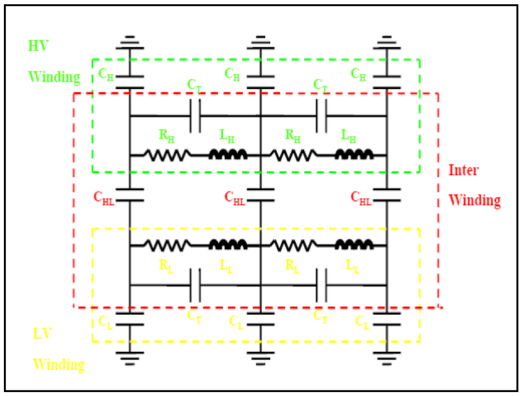

Fig. 1: Equivalent Circuit with Combination RLC Components[6].

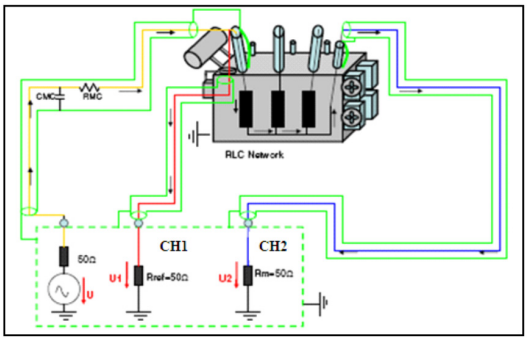

Fig. 2: Connection Setup of SFRA device to the tested transformer [8].

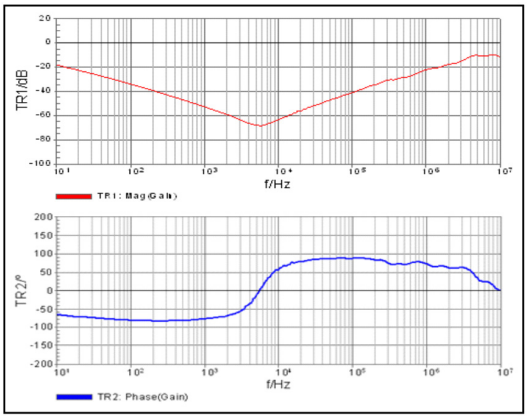

Fig. 3: Graphical Result from SFRA Measurement; upper is magnitude response (dB) and below is phase response (deg).

Short Frequency Ranges of SFRA

Typically, SFRA will produce a magnitude response for the transformer under test in frequency domain, which is shown the correlation between each ranges of the frequency and the transformer transfer function [9]. The transfer function will act as an indicator for the response from each combination parameter inside the transformer. Basically in this paper, the sweep frequency will be generated between 20 Hz and10 MHz. Therefore according to [10], decided to use three ranges of frequency which are defined to indicate different types of faults. In Table 1 shows the elements that are potentially affected by mechanical and electrical faults and the frequency ranges for each part.

Table 1: Frequency Ranges Used In SFRA Interpretation

Frequency Ranges	Sensitive to Elements
Below to 10 kHz (Low Sub Band)	This range affected with the transformer core and magnetic circuits are found.
5 kHz to 500 kHz (Middle Sub Band)	In this range, affected with radial geometrical movement between windings are detected.
400 kHz and above (High Sub Band)	In this range, axial deformations of each single are detectable.

Transformer Models With Simulated Faults

The simulated faults transformer is a single phase step down transformer with 432 turns at the high voltage transformer winding (primary side) and followed with 86 turns at the low voltage transformer winding (secondary side). The transformer will step down the voltage from 240V (Vp) to 48V (Vs).The simulated faults are applied to the low voltage (LV) winding whilst SFRA are measured on the high voltage (HV) winding. Figure 4 shows all types of simulated faults transformer including the healthy transformer developed for this research.

Research Results and Discussions

In this paper, all the SFRA measurement results obtained from the single phase transformer have been simulated with mechanical and electrical faults and also the healthy transformer (reference) are described. For this measured transformer, Fig. 5 until Fig. 11 illustrates the SFRA results which are related to healthy trans former, electrical faults (shorted turn, core damage, open circuit) and mechanical faults (radial, axial), respectively.

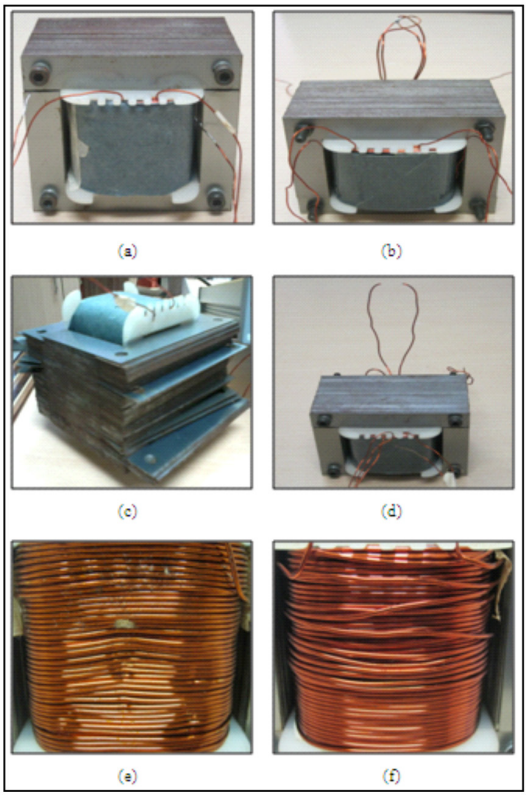

Fig. 4: Transformer Model for each faults (a) Healthy Transformer, (b) Shorted Turns, (c) Core Damage, (d) Open Circuit, (e) Radial Deformations and (f) Axial Displacements Fault.

SFRA Results

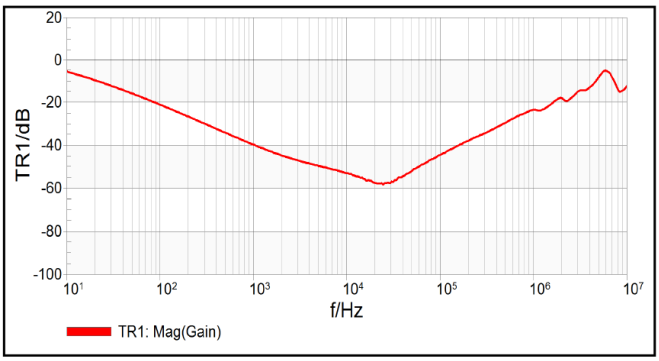

Fig. 5: Healthy Transformer (HV Winding).

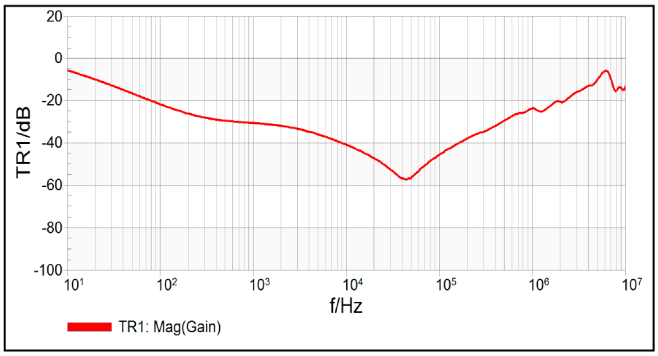

Fig. 6: Shorted Turn Fault (HV Winding).

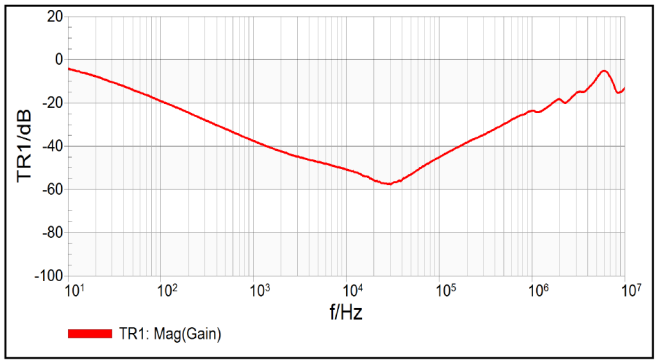

Fig. 7: Core Damage Fault (HV Winding).

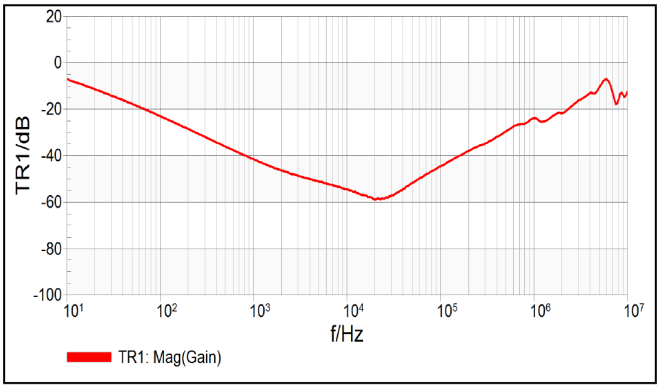

Fig. 8: Open Circuit Fault (HV Winding).

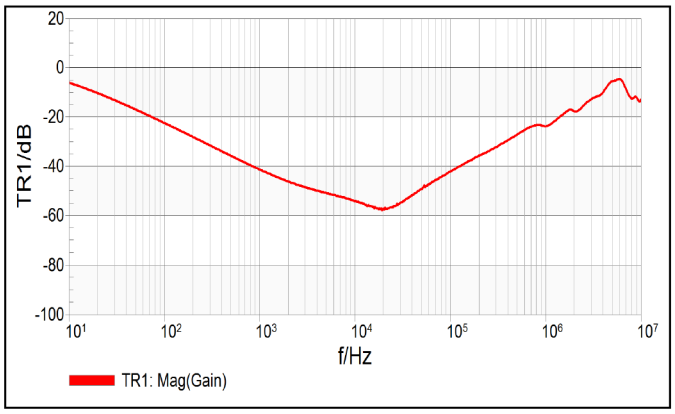

Fig. 9: Radial Deformation (HV Winding).

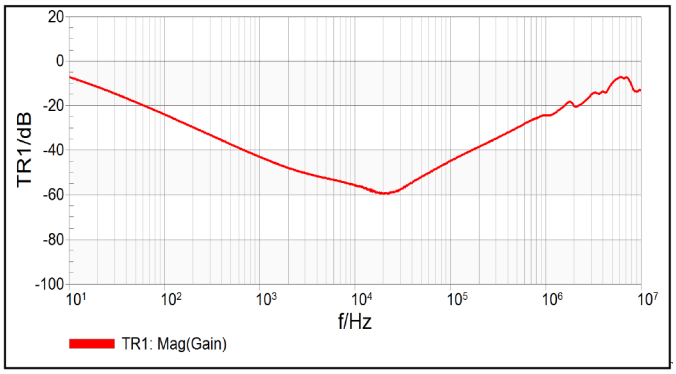

Fig. 10: Axial Displacement (HV Winding).

RESULTS DISCUSSION

To have a clear view on defining the SFRA results characteristics, correlation coefficient function (CCF)equation is used stated in Eq. (1). It is a well-known statistical indicator that indicated relationship between two data sets [11,12]. In this section, the faulty SFRA results data are compared with healthy SFRA results. Table 2 indicates deviation of SFRA results from healthy to the defected transformer. Description of the CCF results in Table 2 is based on selected frequency sub-bands stated in Table 1. In frequency range between 10 Hz – 10 kHz merely for electrical faults (core, shorted and open faults). Meanwhile 5 kHz to 500 kHz is for mechanical faults (radial deformation) and 400 kHz to 10 MHz is for (axial deformation).

Table 2: CCF Results from Comparison Between Healthy and Damage Transformers for Selected Sub Bands

Type of Faults	Measured side of winding	Selected Frequency Sub-Bands		
		10 Hz to 10 kHz	5kHz to 500kHz	400kHz to 10MHz
Core	HV	0.9999	0.9895	0.9997
Shorted		0.9757	0.7072	0.9927
Open		0.9999	0.9976	0.9801
Radial		0.9999	0.9891	0.9920
Axial		0.9998	0.9934	0.9812

Core fault: This experimental study concerns a fault that was simulated on the single phase transformer which has been simulated with core damage faults. The fault is simulated by rearrange the E-I iron core and displace the core in a wrong direction and place. This is intended in order to simulate the real core damage that might determine from the real life transformer fault. The CCF numerical value is 0.9999 in frequency 10 Hz to 10 kHz. From this, it shows that HV winding has a low deviation with 0.01%.

Shorted turn fault: This experimental study concerns a fault that was simulated on the single phase transformer which have been simulated with shorted turn faults. The fault is simulated by shorting the 79th and 80th turn of the LV transformer winding. This is intended in order to simulate the real shorted turn fault that might determine from the real life transformer fault. The CCF numerical value is 0.9757in frequency 10 Hz to 10 kHz. From this, it shows that HV winding has a deviation with 2.43%.

Open winding fault: This experimental study concerns a fault that was simulated on the single phase transformer which has been simulated with open circuit faults. The fault is simulated by cutting one of the turns of LV transformer winding. This is intended in order to simulate the real open circuit fault that might be determined from the real life transformer fault. The CCF numerical value is 0.9999in frequency 10 Hz to 10 kHz. From this, it shows that HV winding has a deviation with 0.01%.

Radial deformation fault: This experimental study concerns a fault that was simulated on the single phase transformer which have been simulated with radial deformations (hoop buckling) faults. The fault is simulated by compressing the LV transformer winding by using a clamp. This is intended in order to simulate the real radial deformations fault that might be determined from the real life transformer fault. The CCF numerical value is 0.9891in frequency 5kHz to 500 kHz. From this, it shows that HV winding has a deviation with 1.09%.

Axial deformation fault: This experimental study concerns a fault that was simulated on the single phase transformer which have been simulated with axial displacement faults. The fault is simulated by making the LV transformer winding to shift each other and displaced from its original place. This is intended in order to simulate the real axial displacement fault that might be determined from the real life transformer fault. The CCF numerical value is 0.9812in frequency 400kHz to 10 MHz From this, it shows that HV winding has a deviation with 1.88%.

CONCLUSIONS

In this paper, SFRA that being used in this experimental study has proven to be valuable diagnostic tools in order to detect core and winding movements and also other faults which affect the impedance of the transformer. It has been used in this SFRA measurement test setup which started in low frequency sub band until high frequency sub band. As the bandwidths of the frequency have been divided into three parts of sub bands, each of the parts has their valuable meanings.

After performing the experimental work, it is proven that the proposed sub bands and the real transformer with simulated faults have related to each other. The single phase transformers models are proved to have an ability to simulate the electrical and mechanical faults. In conclusion, the single phase transformers modelled with simulated mechanical and electrical faults are design completely. Finally, the objective for this project is carrying out successfully.

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Sharin Ab Ghani
Mohd Hambali Roslan
Musa Yusup Lada
Mohd Shahril Ahmad Khiar
Faculty of Electrical Engineering,
Universiti Teknikal Malaysia Melaka (UTeM),
Hang Tuah Jaya,76100, Durian Tunggal, Melaka, Malaysia

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Electromyography Signals on Biceps Brachii Muscle in Time Domain Analysis

Abu Bakar Yahya, Wan Mohd Bukhari Wan Daud
& Chong Shin Horng

ABSTRACT

Features extraction is important for achievement in Electromyography (EMG) signals analysis. Hence, the objective of this paper is to evaluate the features extraction of EMG signals. The experimental setup for acquiring the EMG signals was based on standards that recommended by European's surface electromyography for noninvasive assessment of muscle (SENIAM). The data of EMG signals were analyzed in time domain to get the features. Based on the analysis, four features have been considered based on statistical features. The average of muscle's force condition can be estimate by correlation between sEMG voltage amplitude with linear estimation with full rectified method. These findings could be integrated to design a signal classification based on the features extraction.

Keywords: Electromyography; time domain; features extraction; noninvasive

ABSTRAK

Ciri-ciri pengekstrakan adalah penting bagi keberkesanan analisis dalam isyarat electromyograf (EMG). Oleh itu, objektif kajian ini adalah untuk menilai ciri-ciri pengekstrakan isyarat EMG. Persediaan eksperimen untuk memperolehi isyarat EMG adalah berdasarkan kepada piawaian yang disarankan oleh sebuah pertubuhan Eropah yang berperanan mengawalselia kaedah tidak invasive; '*Surface Electromyograpgy for Noninvasive Assesment of Muscle*' (SENIAM). Data-data daripada isyarat EMG dianalisis dalam domain masa untuk mendapatkan ciri-ciri yang boleh diekstrak. Berdasarkan analisis yang dibuat, empat ciri telah dipertimbangkan berdasarkan kepada ciri-ciri statistik. Purata keadaan daya otot boleh menjadi dianggarkan dengan perkadaran hubungan antara amplitud voltan EMG dengan anggaran linear dengan kaedah memperbaiki isyarat EMG melalui cara positifkan semua isyarat EMG. Hasil kajian ini boleh dijadikan panduan untuk mereka bentuk system pengelasan isyarat EMG berdasarkan kepada ciri-ciri yang telah diektrak.

Kata kunci: Electromyograf; domain masa; ciri-ciri pengekstrakan; tidak invasive

INTRODUCTION

Biosignal is a kind of signal that can be measured and recorded from any organ that represents a physical variable of interest. Electroencephalogram (EEG), electrocardiogram (ECG) and electromyogram (EMG) are among the best known biosignals. EMG is one-dimensional time series signal of the electrical muscle activity that reflects the physiological of the neuromuscular

system upon certain excitation. The technique of detecting, processing and analyzing EMG signals is known as electromyography. It becomes one of the most important physiological signals that are widely studied and used in clinical and engineering applications. However, the intention of using these signals in the field of information technology is still new. This signal is commonly a function of time and is definable in terms of its amplitude, frequency and phase (Ahmed et al. 2009). EMG is a complex signal affected by many aspects such as physiological and anatomical properties and characteristics of instrumentation. It is different from one person to another. Understanding the EMG signals involves the understanding of the skeletal muscles and the methods used to generate the biosignals. It also involves the consideration of the specific mechanisms and phenomena that affect the signals (R and P 2004). The EMG signals are helpful in real-time monitoring. It includes real-time information about the electrical activity of a particular muscle which is related to the muscle's force. The correlation between EMG signals and muscle's force has been reviewed during isometric contractions and dynamic contractions. Many methods and approaches in modeling for computing the muscle's force have been suggested but these models were unable to validated due to lack of an accurate and efficient experimental procedures to compute the muscle's force (Erdemir et al. 2007), (Hug 2011). Recently, most of muscle's coordination is reviewed from surface EMG activity.

Noninvasive measurement is one of the techniques that been used in computing the surface muscle's activity. It is important due to its abilities in supporting many critical biomedical applications for monitoring, diagnostics and therapies. Surface EMG (sEMG) is one of the noninvasive measurement which means a procedure that do not involve tools that break the skin or physically enter the body. In other words, sEMG is a result in space and time of electrical activities with muscles under the skin. The applications of sEMG signals are including in rehabilitation and assistive technology. The most important application of sEMG signal in these fields is to control the prosthesis or other assistive equipments by applying the different patterns of sEMG signal. Furthermore, EMG signal is a sequence of voltages recorded from a contracting muscle over time. The potentials are recorded in the voltage field generated by active muscle cells or fibers of a contracting muscle (Parsaei et al. 2010). The amplitude of the sEMG signal depends on the muscle types and conditions during the observation process and it is about ranges of μV to mV. There are two main types of electrodes that used to measure and record the EMG signals: needle and surface electrodes. The selection of electrode is depends on the purpose and application of the experiment to be carried out. For clinical usage, indwelling electrodes such as concentric needle, monopolar needle and single-fiber needle electrodes are used to measure the EMG signals. The needle electrodes are inserted directly into a muscle and able to measure EMG activity in deep muscles. However, it may cause some pain when inserted into the muscle. The needle electrodes can be difficult to suitably position within a muscle and it may move during muscle contraction. Generally, signals measured via needle electrodes are known as intramuscular EMG signals or more specifically known as needle EMG signals (Parsaei et al. 2010). While, surface electrodes are used in noninvasive application. They were applied to the skin overlying a muscle. The usage of surface electrodes was recommended by the Surface Electromyography for the Non-Invasive Assessment of Muscles (SENIAM) project. The SENIAM project is a European concerted action in the Biomedical Health and Research Program (BIOMED II) of the European Union (Hermens and Freriks 1996). They are convenient and easy to use and do not cause pain. Signals that been measured via the surface electrodes are known as surface EMG (sEMG) signals. The sEMG

signals do not provide much information about deep muscle's activity. This condition happens because of the filtering characteristics of the conduction properties of the overlying muscles and other subcutaneous tissues even though they are easy to detect. The sEMG signals are helpful for diagnostic purposes because it were used to get detailed temporal and spatial information about the fibers of a motor unit (Parsaei et al. 2010).

This paper aimed to evaluate features extracted from sEMG signals on biceps brachii muscle during specific exercises in lifting arm. This research describes the signal processing for single channel sEMG signals on biceps brachii muscle. The sEMG signals then analyzed and estimated its amplitude with muscle's force.

METHODS AND MATERIALS

Experimental Procedures

In pre-experiment, subject must undergo skin preparation procedures. If the skin preparation were done properly, the skin typically gets a light red color that indicates a good skin impedance condition. After skin preparation, the skin impedance then measured. Ohm-resistance between the electrode pair is measured to verify the skin impedance. This experiment is considering the skin impedance. Table I shows the skin impedance reference value for the Ohm-resistance measurement. The quality of an EMG measurement strongly depends on a proper skin preparation and electrode positioning. The aim of skin preparation is to get stable electrode contact and low skin impedance.

Table I: Skin Impedance Reference for Measurement

Impedance Range (kOhm)	Recommendation
1 - 5	Very good condition
5 – 10	Good and recommended if feasible
10 – 30	Acceptable for easy condition
30 – 50	Less good, attention is needed
>50	Should be avoided or requires a second cleaning run

Selection of the electrodes depends on the practical condition and specific aim. In this paper, the noninvasive measurement was used for acquiring the sEMG signal. Surface electrodes are used to measure the EMG of superficial large muscle. It is noninvasive, easy and convenient to use in a laboratory environment. The EMG signal originally initiates from the action potentials of motor units and passes through muscle, skin tissues, electrode-skin interface, amplifier and recorder. These specific mediums and stages act as different filters that changing the amplitude and frequency of the original signal from the motor units as shown in Fig. 1 (Kutz 2009).

Fig. 2 shows the overall work for the proposed study. The EMG signals were recorded using three electrodes; two electrodes for recording the EMG signal and one electrode as reference electrode. The electrodes were placed on the subject's right forearm biceps brachii muscles of healthy subject. The placement of the sEMG electrodes on the skin is according to surface Electromyography for the non-invasive assessment of muscles (SENIAM). This experiment was done in quite room to minimize the noise and can get better signals (Daud and Sudirman 2011).

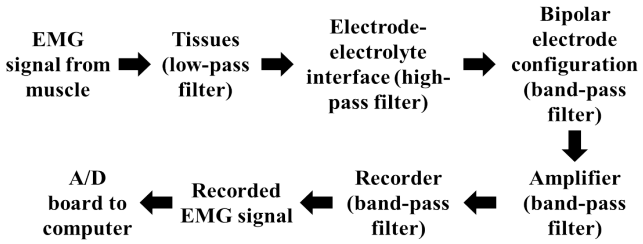

Figure 1: Block diagram of sequences in transferring EMG signal through a typical EMG system of gelled electrode

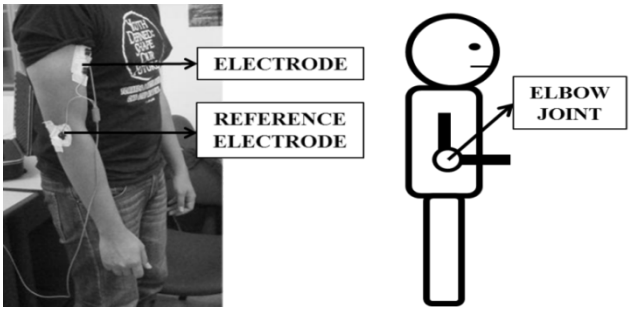

Figure 2: The experimental setup

The subject was standing straight to get a straight and upright posture as shown in Fig. 2. Data for this experiment are recorded continuously. These data will be used for estimating the average of muscle's force at biceps brachii muscle. Subject need to lift hand freely without load and with load of 2 kg, 4 kg and 6 kg. The repeatability for each load is 30 times.

The subject then been supervised by an instructor to lift their hand without load and with a dumbbell load of 2 kg, 4 kg and 6 kg. 6 kg is a capable maximum load that a normal and healthy person, including male and female, can lift by using a dumbbell on single hand. Person with right dominant hand was chosen for this experiment. Right hand was used for this experiment in order to minimize the interference with signals from heartbeat, electrocardiogram (ECG). During the experiment, the right hand of the subject was lift from $\theta_E = 0^0$ to $\theta_E = 145^0$; refer at the elbow joint. The subject lifted hand with distinct weights starting from no load to heavier weight. 145^0 is the maximum range of flexion at the elbow joint. Subjects lift the load from $\theta_E = 0^0$ in 2 seconds and hold at $\theta_E = 145^0$ for 6 seconds; then lowering back the load to $\theta_E = 0^0$ in 2 seconds as shown in Fig. 3. Holding the load for period of 6 seconds is function as indicator to make sure that the EMG signals are reaching its maximum amplitude. During the experiment, the subject should not move their shoulder. They only lift the load by using their hand, while the load is placed at the hand. Fig. 4 shows the position of the hand during flexion. Subject had 5 minutes of rest during exchange from one weight of load to another in order to avoid muscles fatigue.

Subjects

A normal and healthy male subject was participated in this study. The subject was selected according to dominant hand; right-handed, and weight; above 60 kg. The subject is voluntary and has signed a consent form before the experiment is conducted. Consent form is a form statement

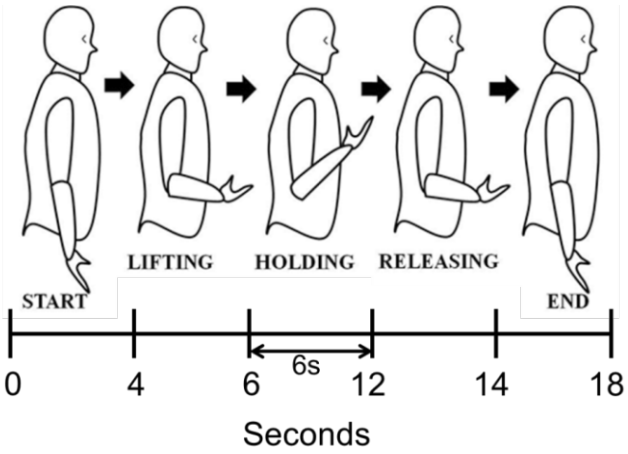

Figure 3: The position of hand during flexion Subjects

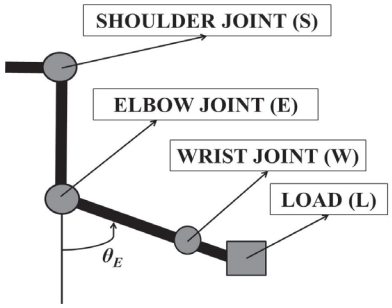

Figure 4: The movement of the subject

that has been signed by the subject which means that the subject is volunteer, understand and aware with the consequence of the experiment that will be conducted. This is for a precaution if anything happen to the subject after the experiment.

System Design

This experiment uses basic system for acquiring biosignals. Starting from electrodes, data acquisition until signal processing was designed. Fig. 5 below shows the block diagram of the designed system in this experiment. The system design includes the sEMG self-adhesive silver-silver-chloride (Ag/AgCl) surface electrodes that used as transducer to capture the EMG voltage signal. It was attached to the biceps brachii muscle on the right hand. Ag/AgCl electrodes are chosen due to their half-cell potential is closer to zero compared to other types such as silicon rubber electrodes. Three Ag/AgCl electrodes were used in this experiment for a subject. Independent measurement can be obtained from the hand movement without moving the shoulder.

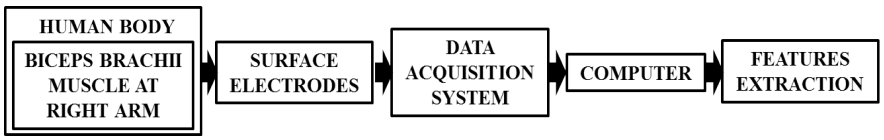

Figure 5: Block diagram of the system

The captured EMG signal from the surface electrodes then being digitized by the sEMG data acquisition system; TeleMyo 2400T G2 (Noraxon, USA Inc.). The sEMG data acquisition system is used to record EMG signals from the subjects. The EMG signals were obtained by using the TeleMyo 2400T G2 Transmitter, which sends the signals via wireless transmission to the TeleMyo PC-Interface Receiver that forward the data via USB to the computer at a sampling rate of 1500 samples per second. A computer was used as digital signal processing system; which is digital rectification and features extraction.

PROCESSING THE EMG SIGNAL

Rectification

The recorded data of the raw EMG signals contains very important information may use as a first objective information and documentation of the muscle. The EMG signals consist of positive and negative phases that change about a baseline of zero voltage (isoelectric line). Rectification is important due to the fluctuation characteristic of the EMG signal about zero value. The implementation of the rectification is done via taking the absolute value of the sEMG signal, which is inverting the negative phases as shown in Fig. 6. In this study, the raw data of sEMG signals was rectified via full rectified method. This method is using Equation 1 for full rectified the raw data of sEMG signals.

$$y_i = |x_i| \tag{1}$$

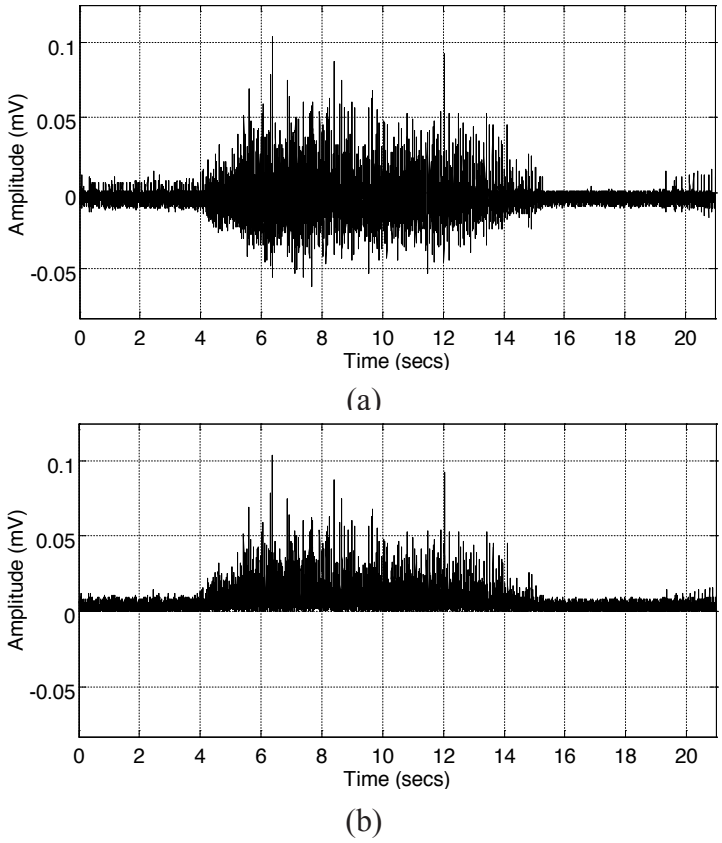

Figure 6: Rectification of raw EMG signal: (a) original raw EMG signal; (b) full rectified EMG signal.

Time Domain Features

Features in time domain have been widely used in medical and engineering practices and researches. Time domain features are used in signal classification due to its performances of signal classification in low noise environments, lower computational complexity, easy and quick implementation. Furthermore, the features are calculated based on raw EMG time series. The disadvantage of time domain is the statistical properties of the EMG signal are changing over time. However, the time domain features assume the data as a stationary signal (Phinyomark, Phukpattaranont, and Limsakul 2012). Moreover, much interference that is acquired through the recording because of their calculations is based on the EMG signal amplitude. Four time domain features have been proposed in this study through extensively review the literatures.

Features Extraction

The information of statistical features extraction for the EMG signals were been done in MATLAB R2011a. Four statistical features from time domain are used in evaluation. The four statistical features based on time domain are described as follows

1. *Integrated EMG:* Integrated EMG (IEMG) is defined as a summation of absolute value of the EMG signal amplitude. It usually used as an onset detection index in EMG non-pattern recognition and clinical application(Phinyomark, Phukpattaranont, and Limsakul 2012). It can be expressed as

$$\text{IEMG} = \sum_{i=1}^{N} |x_i| \tag{2}$$

2. *Mean Absolute Value:* Mean absolute value (MAV) is an average of absolute value of the EMG signal amplitude in a segment. It normally used in detection of the surface EMG signal for the prosthetic limb control. It can be expressed as

$$\text{MAV} = \frac{1}{N} \sum_{i=1}^{N} |x_i| \tag{3}$$

3. *Variance:* Variance (VAR) is defined as an average of square values of the deviation of variable. However the mean value of the EMG signal is close to zero. It can be expressed as

$$\text{VAR} = \frac{1}{N-1} \sum_{i=1}^{N} |x_i^2| \tag{4}$$

4. *Root Mean Square:* Root mean square (RMS) is another feature that popular in EMG signal analysis. RMS is defined as the square root of the mean over time of the square of the vertical distance of the graph from the rest state which related to the constant force and non-fatiguing contraction of the muscle. In most cases, it is similar to standard deviation method. It can be expressed as

$$\text{RMS} = \sqrt{\frac{1}{N} \sum_{i=1}^{N} |x_i^2|} \tag{5}$$

RESULT AND DISCUSSION

Characteristics of EMG Signal

The EMG data in this study are measured during hand lifting without load and with a dumbbell load of 2 kg, 4 kg and 6 kg. Fig. 7 shows the raw EMG signals during the experiment. As can be observed in Fig. 7, when the muscle contraction was maintained for a long period, the EMG signal amplitude was decreased. It proves that the EMG signal is a non-stationary signal which the frequency of the signal changes over time. Furthermore, the relationship between changing in force during muscle contraction and increasing of load can be observed in Fig. 7. The amplitudes of EMG signals are increasing as the load increases. The amplitudes of EMG signals for 6 kg load as shown in Fig. 7(d) are higher than 4 kg. While the amplitudes of EMG signals for 4 kg load as shown in Fig. 7(c) are higher than signal obtain from lifting hand with 2 kg load and no load. The amplitudes of EMG signals for no load have been selected as the reference amplitudes of EMG signals in this experiment. Fig. 7 shows that the EMG signals get the maximum amplitude at the early stage of the recorded signal. It shows that the muscle contraction is high when the subject starts to lifting the load. While the EMG signal amplitude were decreasing at the last stage of the recorded signal because the subject is lowering down the load in order to release the load.

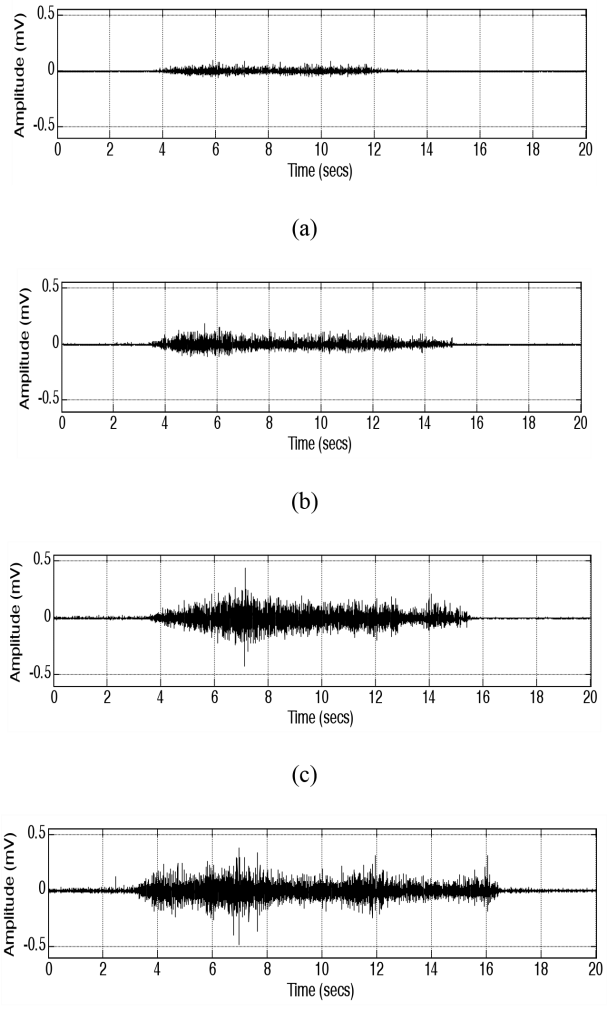

Figure 7: Raw EMG signals for load of: (a) no load, (b) 2 kg, (c) 4 kg, (d) 6 kg

Assessing the EMG Features

The EMG signals were analyzed in time domain to get the features. Overall four time domain features were selected and analyzed from biceps brachii muscle for load lifting. Table I shows the average value of time domain features for four different loads that obtained from the EMG signals. As can be observed in Table II, the statistical features for the EMG signal is verify for each load. The statistical features were increase when the load increases. The maximum amplitude of the EMG signals is increasing as the load increases. This situation occurs due to more force needed to lift the load when the load increases. From Fig. 8, we can see that the relationship between change in load and the time domain features. As overall, the value of the features is increase due to increasing of the EMG signal amplitude according to increasing weight of load. The results show that the value of the features is different between different loads. It can be used to classify the EMG signal according to the time domain features and weight of loads.

Table II: Average Value of Time Domain Feaures for Four Different Loads

Load	Time Domain Features (mV)			
	IEMG	MAV	VAR	RMS
0 kg	149.2	0.0076	0.0001204	0.01136
2 kg	302.2	0.01435	0.0004969	0.02241
4 kg	462.5	0.02442	0.00157	0.03959
6 kg	652.2	0.03325	0.00328	0.05681

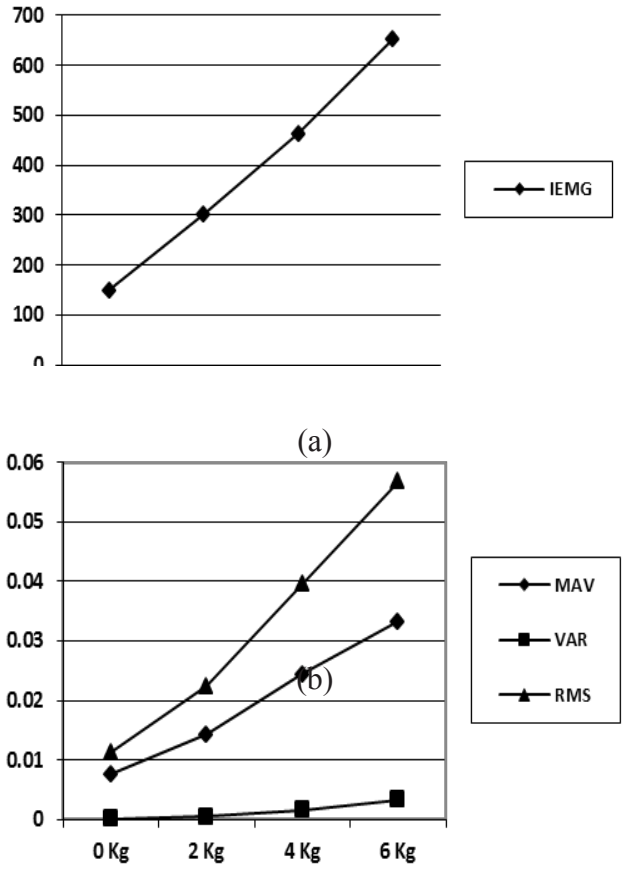

Figure 8: Relationship of time domain features with load: (a) IEMG; (b) MAV, VAR, RMS

EMG Muscle's Force Estimating

Fig. 9 and Table III show the correlation about load and sEMG voltage amplitude in average (mean). It can be seen that the correlation between loads and sEMG voltage amplitudes is almost linear with R^2 equal to 0.99. By using full rectified, average of muscle's force can be estimated using equation 8.

$$y = 166.93x - 25.8 \quad (6)$$

$$V = 166.93F - 25.8 \quad (7)$$

Hence

$$F = 0.006V + 0.1546 \quad (8)$$

for $0g \leq F \leq 6g$

where g = local gravitational field
= 9.8067 m/s2

In equation 8, V is sEMG voltage, F is average of muscle's force and g is gravity coefficient. Note that this force should be multiply with gravity. It means that while V is 200mV, then F is 0.1558g Newton for full rectified method.

Table III: Experiment Resume

No	Activity	IEMG (mV)
1	Lifting arm without load	149.2 ± 11.13
2	Lifting arm with 2kg load	302.2 ± 24.46
3	Lifting arm with 4kg load	462.5 ± 42.04
4	Lifting arm with 6kg load	652.2 ± 91.78

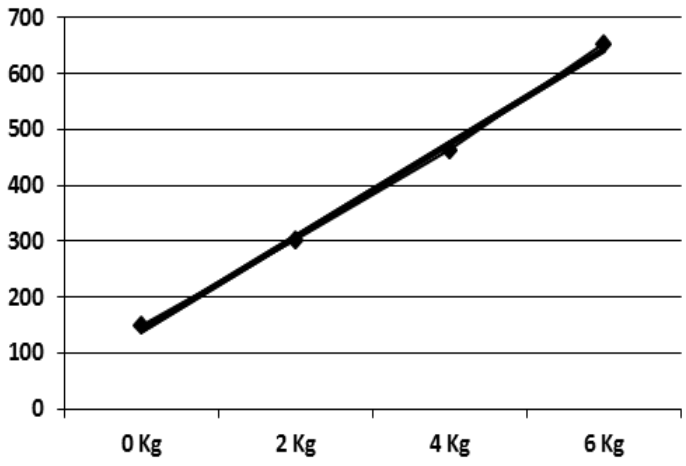

Figure 9: Correlation between load and sEMG voltage amplitude.

CONCLUSION

This study is targeted to researchers to look in details of the features that can be extracting from the EMG signal within hand-lifting four different loads for better interpretation of EMG signals analysis on time domain. There are four features have been extracting from the EMG signals: IEMG, MAV, VAR and RMS. Furthermore, the average of muscle's force condition can be estimate by the correlation between sEMG voltage amplitude with linear estimation with full rectified method. These findings could be integrated to design a signal classification based on the features extraction.

ACKNOWLEDGMENT

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Abu Bakar Yahya, Wan Mohd Bukhari Wan Daud &
Chong Shin Horng
Faculty of Electrical Engineering,
Universiti Teknikal Malaysia Melaka (UTeM)
Hang Tuah Jaya,
76100 Durian Tunggal,
Melaka, Malaysia

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Tahap Realistik Karektor Animasi *Talking-Head* dan Kesannya Terhadap Prestasi Pelajar: Suatu Kerangka Konseptual Kajian untuk Pembelajaran Lingustik

Mohd Najib Hamdan & Ahmad Zamzuri Mohamad Ali

ABSTRACT

Many students who learn English as second language have difficulty with English pronunciation, which consequently contributes to students' poor communicative power. Therefore, talking-head animation appeared to be sufficient instructional material in supporting language learning, especially in pronunciation aspect. However, human tend to fell creepy and uncomfortable when the animation's character was designed with realism appearance or look too human. This phenomenon has been proved through a graph produced by a Japanese robotics namely the Uncanny Valley. Based on this, the paper proposed a research conceptual framework for talking-head animation with different level of realism, specifically on students' pronunciation learning and effects on students' emotion throughout learning process. The framework was developed based on theories and literature overview done.

Keyword: Animation, pronunciation, uncanny valley, talking-head, level of realism, emotion

PENGENALAN

Animasi dilihat mampu memberi kesan signifikan kepada peningkatan prestasi dan motivasi pelajar (Lin & Lai, 2011; Heafner, 2004). Ini kerana, reka bentuk, pengolahan bahan dan interaktivitinya mampu menarik minat dan perhatian pelajar terhadap proses pembelajaran (Jamaluddin & Zaidatun, 2001). Selain itu, animasi juga mampu memberi gambaran sesuatu pelajaran dengan lebih jelas seterusnya meningkatkan tahap kefahaman pelajar (Rieber & Kini, 1991). Dari sudut teori pula, persembahan animasi dapat menggerakkan saluran verbal dan visual di dalam memori pelajar yang merupakan strategi berkesan dalam memperoleh, menyimpan dan mengingat maklumat secara berkesan (Mayer & Moreno, 2002; Mayer, 2001; Paivio,1986). Berdasarkan kelebihan ini, bidang linguistik terutamanya pembelajaran Bahasa Inggeris, dilihat juga mempunyai potensi untuk memanfaatkan animasi dalam proses pembelajaran. Ini kerana, penggunaan animasi sebagai ABBM dapat membantu warga pendidik mengatasi masalah komunikasi dalam kalangan pelajar (Chih & Yih, 2012). Hal ini dibuktikan melalui kajian Lin dan Chen (2007) yang mendapati, penggunaan koswer animasi berjaya meningkatkan prestasi pembacaan pelajar dalam Bahasa Inggeris. Ini disebabkan, kesan visualisasi menarik yang terdapat dalam koswer animasi tersebut telah mempercepatkan proses pembelajaran pelajar. Hasilnya, pelajar didapati mampu berkomunikasi menggunakan Bahasa Inggeris dalam suatu tempoh yang singkat (Lin & Chen, 2007).

Kemahiran berkomunikasi di dalam Bahasa Inggeris dalam kalangan pelajar-pelajar Institut Pengajian Tinggi (IPT) di Malaysia masih berada pada tahap yang tidak memuaskan (Adibah & Azizah, 2010). Isu ini sebenarnya amat membimbangkan dimana ianya melibatkan pelajar IPT yang akan bersaing di pasaran kerja. Mengikut laporan Institut Penyelidikan Pendidikan Tinggi Negara (IPPTN), masalah utama penganguran yang berlaku dalam kalangan graduan adalah disebabkan faktor kelemahan berkomunikasi dalam Bahasa Inggeris (Institut Penyelidikan Pendidikan Tinggi Negara, 2003). Laporan IPPTN ini selari dengan kajian Azizan dan Mun (2011) yang mendapati bahawa 60 peratus graduan di Malaysia menghadapi masalah komunikasi dalam Bahasa Inggeris semasa sesi temuduga dijalankan.

Lantaran itu, beberapa kajian telah dijalankan bagi mengenalpasti punca permasalahan ini. Antara punca yang dikenalpasti adalah kelemahan dari sudut sebutan perkataan secara betul (Saran, Saferoglu & Cagiltay, 2008). Hal ini berlaku kerana penggunaan teknologi yang terhad dalam proses pembelajaran Bahasa Inggeris telah mengakibatkan kegagalan dalam menarik perhatian pelajar untuk mempelajarinya (Shyamlee, Skills, & Vidyanagar, 2012). Sehubungan itu, penggunaan teknologi seperti animasi *talking-head* didapati mampu meningkatkan motivasi dan prestasi pelajar terutamanya dalam aspek sebutan perkataan secara tepat (Wik & Hjalmarsso, 2009; Rathivellu, Thiagrajan & Rajkumar, 2007; Massaro & Light, 2004; Beskow & Barker, 2003). Ini berikutan, ciri-ciri animasi *talking-head* yang menarik, terutamanya dalam paparan 3 dimensi serta struktur anatomi yang terdapat pada kerektor animasi tersebut, mampu memberi kesan positif terhadap ingatan pelajar (Obstermann & Liew, 2009).

Walau bagaimanapun, bagi memastikan animasi *talking-head* berupaya memberi impak maksimum terhadap pembelajaran, faktor tahap realistik karektor animasi merupakan antara elemen terpenting yang perlu diberi penekanan dalam fasa reka bentuk animasi instruksi (Yang, Wang & Schneider, 2007). Dari sudut teori, faktor tahap realistik berpontensi mengakibatkan keselesaan dan emosi manusia terganggu, terutamanya apabila sesuatu karektor animasi hampir menyerupai manusia sebenar (Kaba, 2013; Tinwell et al., 2010). Walaupun begitu, kesan tahap realistik ini masih kurang diberi penekanan terutamanya yang melibatkan industri animasi (Angeli, 2012; Moore, 2012). Sebagai contoh, karektor animasi yang terlalu realistik digunakan bagi watak-watak utama filem *Final Fantasy,* telah menjadi antara penyebab yang menyumbang kepada kegagalan filem tersebut mencapai sasaran yang ditetapkan (Geller, 2008). Hal ini juga disokong melalui kajian yang dijalankan oleh Tinwell et al. (2010), yang mendapati penggunaan karektor animasi 3 dimensi yang terlalu realistik dalam permainan video memberi impak ketidakselesaan kepada pemain permainan video tersebut.

Secara umumnya, tahap realistik karektor animasi 3 dimensi adalah lebih tinggi berbanding karektor animasi 2 dimensi (Oddey & White, 2009). Ini bermaksud, tahap keselesaan dan emosi manusia akan lebih terkesan apabila karektor animasi 3 dimensi digunakan di dalam sesuatu produk animasi, berbanding sekiranya karektor animasi 2 dimensi digunakan (Oddey & White, 2009). Namun begitu, kesan kelesaan dan emosi manusia terhadap karektor animasi 3 dimensi boleh dikawal sekiranya reka bentuk karektor tersebut tidak terlalu realistik (Ventrella, 2011; Hanson, Olney, Prilliman, Methews & Zielke, 2005). Hal ini dibuktikan melalui penggunaan karektor animasi 3 dimensi tidak realistik dalam filem *Shrek, Incredible* dan *The Advanture of Tintin,* yang telah mendapat sambutan menggalakkan dalam pasaran industri perfilemen dunia (Kaba, 2013; Butler & Joshko, 2007). Namun, timbul persoalan, adakah faktor ini juga

mempunyai impak terhadap animasi instruksi? Kebanyakan kajian terhadap kesan tahap realistik tertumpu pada industri perfileman dan sangat kurang dalam bidang pendidikan (Brutcher, 2013). Sehubungan itu, adalah penting kajian dijalankan bagi melihat kesan tahap realistik terhadap pengajaran dan pembelajaran berasaskan animasi.

Lanjutan dari itu, bagi mengelakkan kesan faktor tahap realistik ini terus wujud dalam bahan pengajaran dan pembelajaran berasaskan animasi, telah timbul perbincangan bagi menggantikan semula karektor animasi dengan karektor manusia sebenar yang lebih bersifat konvensional (*University of Cambridge*, 2013). Sehubungan itu, kajian telah dijalankan oleh *University of Cambridge* (2013), untuk mengenalpasti sama ada penggunaan karektor manusia sebenar ada memberi kesan terhadap keselesaan dan emosi pelajar. Malangnya, kajian tersebut turut menunjukkan kesan terhadap tahap keselesaan dan emosi masih wujud. Ini kerana, emosi negatif seperti emosi marah yang ditunjukkan oleh karektor manusia sebenar, telah menyebabkan emosi pelajar terganggu sepanjang proses pembelajaran. Hal ini dilihat akan berupaya menyumbang kepada kemerosotan tahap pembelajaran pelajar (*University of Cambridge*, 2013). Bagi mengatasi masalah tersebut, *University of Cambridge* telah mencipta suatu bahan instruksi yang dinamakan *Zoe talking-head* yang mempunyai filtur membolehkan pelajar memilih emosi yang bersesuaian dengan perasaan mereka. *Zoe talking-head* masih lagi mengekalkan penggunaan karektor manusia sebenar. Melalui penggunaan *Zoe talking-head*, kesan emosi ke atas pelajar sebelum ini dilihat dapat dielakkan, disamping telah memberi impak positif terhadap prestasi pelajar (*University of Cambridge*, 2013).

Secara kesimpulannya, faktor tahap realistik perlu diberi perhatian serius terutamanya dalam proses mereka bentuk karektor animasi untuk bahan instruksi. Justeru itu, kajian ini akan melihat dan mengenal pasti tahap realistik yang bersesuaian bagi animasi *talking-head* untuk pembelajaran Bahasa Inggeris. Mengambil kira perbincangan di atas, tiga prototaip animasi *talking-head* dengan tahap reaslistik berbeza dan satu prototaip t*alking-head* manusia sebenar sebagai kawalan akan dibangunkan dan diuji keberkesanannya. Secara ringkasnya, empat prototaip tersebut adalah seperti berikut:

1. Karektor animasi *talking-head* 2 dimensi (2D)
   Strategi ini akan menggunakan karektor animasi 2D beserta audio dan teks perkataan yang disebut oleh karektor animasi tersebut.
2. Karektor animasi *talking-head* 3 dimensi yang tidak realistik (3D-TR)
   Strategi ini akan menggunakan karektor animasi 3D yang tidak realistik beserta audio dan teks perkataan yang disebut oleh karektor animasi tersebut.
3. Karektor animasi *talking-head* 3 dimensi yang realistik (3D-R)
   Strategi ini akan menggunakan karektor animasi 3D realistik yang hampir menyerupai manusia beserta audio dan teks perkataan yang disebut oleh karektor animasi tersebut.
4. Karektor *Talking-head* Manusia Sebenar (Manusia)
   Strategi ini akan menggunakan manusia sebenar beserta audio dan teks perkataan yang disebut oleh manusia tersebut.

Pernyataan Masalah

Berdasarkan tinjauan awal yang telah dijalankan, didapati majoriti pelajar memberi alasan bahawa kaedah pengajaran Bahasa Inggeris secara konvensional adalah antara punca prestasi

kurang memuaskan mereka. Permasalahan ini sekiranya tidak ditangani dengan berkesan, ianya berpotensi menyumbang kepada penganguran graduan. Ini merujuk kepada kajian pengesanan graduan yang mendapati kemahiran Bahasa Inggeris merupakan keperluan utama graduan IPT yang belum bekerja pada tahun 2010 (Kementerian Pengajian Tinggi, 2010).

Jadual 1.1: Kemahiran yang diperlukan Graduan Tidak Bekerja yang Berbeza IPT

Program Latihan Tambahan	IPTA (n=19,928)	IPTS (n=5,012)	Politeknik (n=7,367)	Kolej Komuniti (n=1,598)	Keseluruhan (n=33,905)
			(%)		
Kemahiran Berbahasa Inggeris	72.6	69.5	80.4	77.2	74.1
Pembangunan Kerjaya	57.4	62.7	59.3	60.0	58.7
Kemahiran Teknologi Maklumat dan Komunikasi	54.2	53.2	64.5	59.3	56.5
Kemahiran Interpersonal	59.9	60.8	46.4	40.7	56.2
Latihan Keusahawanan	52.6	48.8	46.7	60.3	51.1

Sumber (Kementerian Pengajian Tinggi, 2010)

Hal ini tidak seharusnya berlaku kerana setiap IPT telah menetapkan jumlah jam kredit tertentu mengikut piawai Agensi Kelayakan Negara (MQA) untuk pembelajaran Bahasa Inggeris. Namun, permasalahan ini berterusan berlaku terutamanya di pusat pendidikan teknik dan vokasional seperti Kolej Komuniti. Permasalahan ini mungkin menyumbang kepada kadar penganguran yang tertinggi dalam kalangan graduan Kolej Komuniti berbanding IPT lain iaitu sebanyak 41.1 peratus (Kementerian Pengajian Tinggi, 2010).

Kelemahan penguasaan Bahasa Inggeris dalam kalangan pelajar IPT dikenalpasti melibatkan empat elemen utama iaitu lisan, bacaan, pendengaran dan penulisan. Secara keseluruhan kemahiran lisan, pendengaran dan bacaan merupakan kelemahan utama yang dikenalpasti menjadi permasalahan seperti mana maklumat yang diperolehi dari graduan menganggur (IPPTN, 2003). Merujuk kepada kelemahan ini, pembelajaran sebutan perkataan dilihat sangat praktikal ditekankan bagi mengatasi tiga masalah utama yang dikenalpasti ini. (Saran, Saferoglu & Cagiltay, 2008). Sehubungan itu, penggunaan ABBM seperti animasi *talking-head* amat releven dicuba bagi mengatasi masalah kaedah pembelajaran konvensional yang kurang diminati oleh pelajar (Ostermann, Che., & Huang, 1998). Animasi berpontensi membantu pelajar menyebut sesuatu perkataan dengan betul serta mudah untuk diingati (Wik et. al, 2009). Disamping itu, pelajar juga dapat menggunakan ABBM animasi *talking-head* ini untuk pembelajaran kendiri (Nielson, 2011). Perkara ini amat bersesuaian dengan strategi pembelajaran sepanjang hayat yang menjadi pendekatan di sistem Kolej Komuniti (Wan Ahmad, Wan Rashid, Mohd. Hashim, Mohamad Hisyam, Abdul Razzaq & Abdul Rasid, 2011).

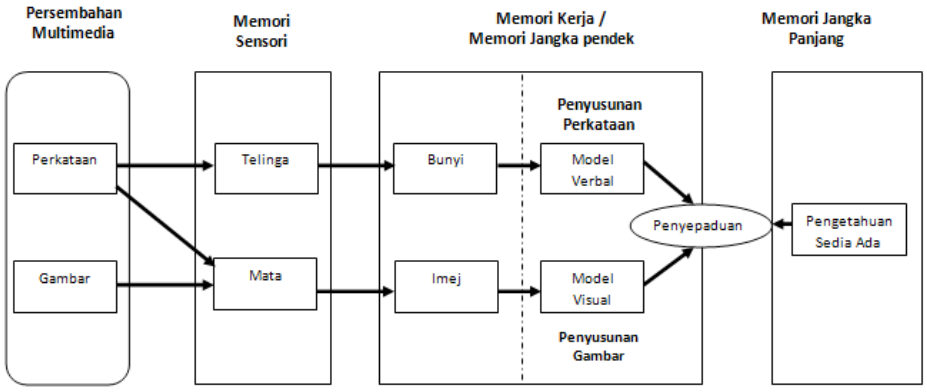
Walau bagaimanapun, penggunaan animasi *talking-head* akan menjadi isu sekiranya ia tidak memberi kesan positif yang diharapkan. Peruntukkan dan perbelanjaan dalam menyediakan animasi ini akan menjadi sia-sia jika penggunaannya tidak dapat mengatasi keberkesanan kaedah konvensional (Ting & Woo, 2005). Oleh itu, kajian ini akan mengenalpasti strategi persembahan animasi *talking-head* yang bersesuaian agar kesan terhadap pencapaian pelajar dapat ditingkatkan melalui penggunaannya.

Kerangka Konseptual Kajian

Kerangka konseptual kajian ini dibina bersandarkan kepada tiga teori utama, iaitu teori kognitif pembelajaran melalui multimedia Mayer, teori *Uncanny Valley dan* teori pembelajaran konstruktivisme.

Teori kognitif pembelajaran melalui multimedia Mayer secara umumnya membincangkan hubung kait *dual coding* yang melibatkan tiga sistem memori iaitu memori sensori, memori kerja dan memori jangka panjang. Teori ini membahagikan saluran maklumat kepada dua komponen, iaitu saluran verbal dan saluran visual (Mayer, 2001). Secara khususnya, teori ini menyatakan bahawa seseorang pelajar yang menggunakan multimedia akan melalui tiga proses kognitif utama. Proses kognitif pertama adalah memilih audio dan teks bagi pemprosesan di dalam memori kerja verbal dan memilih imej atau grafik bagi pemprosesan di dalam memori kerja visual. Proses kognitif kedua ialah menterjemah audio dan teks yang dipilih menjadi model mental verbal dan menterjemah segala imej dan grafik yang dipilih menjadi model mental visual. Proses kognitif ketiga pula ialah menggabungkan model mental verbal dan model mental visual yang dibina serta pengetahuan sedia ada yang dimiliki untuk pembentukan skema bagi didaftar secara kekal di dalam memori jangka panjang (Sweller, 2002; Mayer, 2001; Mayer, Steinhoff, Bower & Mars, 1995).

Melalui pengintergrasian kedua-dua saluran verbal dan saluran visual di dalam memori kerja, sebenarnya berpontensi mengurangkan bebanan kognitif di dalam memori jangka panjang untuk pembelajaran berkesan (Jong, 2009; Sweller, 1994; 1988). Ini bersandarkan prinsip andaian kapasiti terhad yang menyatakan bahawa, maklumat yang terhad sahaja dapat diproses di dalam memori kerja dalam sesuatu tempoh masa (Mayer, 2001). Bagi menangani masalah ini, pengunaan kedua-dua saluran secara serentak mampu membantu pelajar memproses sesuatu maklumat yang diterima dengan lebih berkesan, seterusnya menghasilkan pembelajaran yang lebih bermakna berbanding penggunaan hanya satu saluran sahaja (Paivio,1986). Proses kognitif ini digambarkan seperti rajah 1.1.

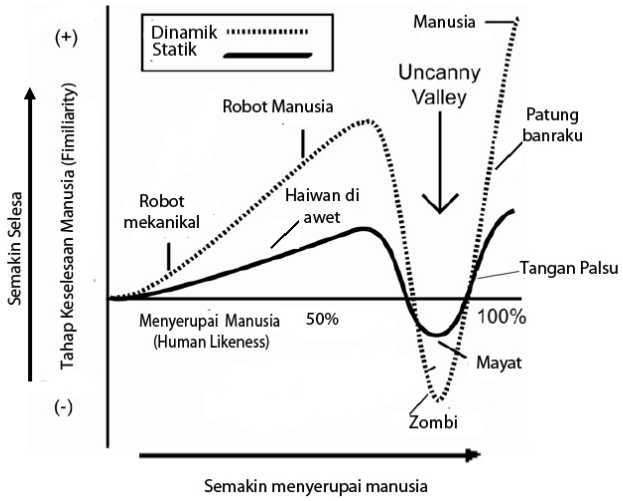


Rajah 1.1: Model Teori Kognitif Pembelajaran Melalui Multimedia Mayer
(Sumber : Mayer, 2001)

Dilihat dari sudut teori ini, animasi *talking-head* berpontensi melibatkan penggunaan saluran visual dan saluran verbal sepanjang proses pembelajaran. Dimana, ekspresi muka dan pergerakan bibir animasi *talking-head* akan diproses malalui saluran visual dan audio serta teks diproses

melalui saluran verbal. Namun begitu, pembelajaran bermakna mungkin terganggu sekiranya reka bantuk karektor animasi yang tidak tepat digunakan, walaupun bebanan kognitif pelajar dapat dikurangkan melalui pengunaan kedua-dua saluran visual dan saluran verbal. Ini kerana, faktor realistik sesuatu karektor animasi akan memberi kesan terhadap tahap keselesaan dan emosi pelajar sepanjang proses pembelajaran, terutamanya melalui penggunaan karektor animasi yang terlalu realistik (Tinwell et al., 2011; MacDorman, Green & Koch, 2009; Minato, Shimda, Ishuguro & Itakura, 2004). Kesan ini juga mungkin memberi impak terhadap kejayaan bahan instruksi berasaskan animasi terhadap pembelajaran. Sehubungan itu adalah penting kajian dilakukan untuk melihat kesan tahap realistik karektor animasi terhadap pembelajaran.

Kesan yang wujud dari faktor tahap realistik sesuatu karektor animasi boleh dilihat dalam teori *Uncanny Valley* yang merupakan teori kedua disandarkan dalam kajian ini. Teori *Uncanny Valley* merupakan suatu teori yang menerangkan hubungan di antara perbezaan tahap realistik sesuatu karektor terhadap keselesaan dan emosi manusia (MacDorman, 2006). Teori ini telah menggambarkan hubungan tersebut melalui graf *Uncanny Valley* yang dibina seperti dalam rajah 1.2.



Rajah 1.2: Teori *Uncanny Valley* oleh Masahiro Mori
Sumber (MacDorman, 2005)

Berdasarkan rajah 1.2, teori *Uncanny Valley* membahagikan karektor kepada dua kategori utama, iaitu karektor dinamik dan karektor statik. Hasil kajian yang diterjemah kepada graf ini menunjukkan bahawa tahap keselesaan manusia (*fimiliarity*) meningkat apabila karektor tersebut semakin menyerupai manusia (*human likeness*). Graf tahap keselesaan manusia (*fimiliarity*) didapati menurun ke paras negatif sehingga ke tahap 80 hingga 85 peratus bagi kedua-dua karektor dinamik dan statik apabila karektor tersebut semakin mengerikan. Penurunan tahap keselesaan manusia pada graf ini dinamakan *Uncanny Valley*. *Uncanny Valley* ini juga memberi kesan ngeri dan takut terhadap penonton selari dengan reka bentuk dan ekspresi muka karektor yang semakin realistik menyerupai manusia (MacDorman, Green, Chin &, Koch, 2009). Namun, graf tahap keselesaan manusia *(fimiliarity*) kembali meningkat ke paras positif apabila karektor tersebut

adalah manusia sebenar (MacDorman, 2005). Berpandukan graf ini juga, didapati bahawa kesan *Uncanny Valley* adalah lebih tinggi terhadap karektor dinamik berbanding karektor statik.

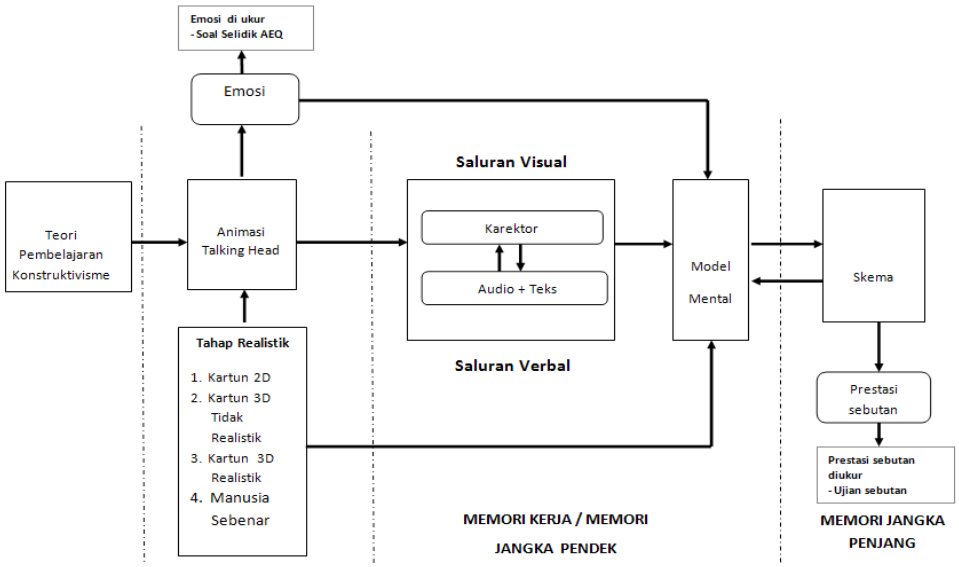
Walaupun teori ini dibina untuk mengenalpasti kesan tahap realistik bagi tujuan kajian robotik, namun ianya juga mungkin mempunyai kesan yang sama terhadap karektor animasi *talking-head*. Ini kerana, karektor animasi juga mempunyai tahap realistik yang berbeza berdasarkan kategori animasi. Oleh itu, adalah penting kajian dilakukan untuk membina graf tahap keselesaan terhadap tahap realistik animasi instruksi, terutamanya animasi *talking-head*.

Selain dari melihat kesan tahap realistik yang berbeza terhadap reka bentuk karektor animasi, penekanan terhadap teori pendidikan dalam proses pembelajaran adalah juga penting diambil kira walaupun animasi instruksi yang dibangunkan adalah sempurna dari sudut teori (Neo & Neo, 2009; Vickneasvari, 2007). Berdasarkan kajian Pusat Perkembangan Kurikulum Kementerian Pendidikan Malaysia menunjukkan bahawa teori pembelajaran konstruktivisme merupakan teori pembelajaran yang terbaik disebabkan teori ini beranggapan murid bukan hanya menerima pengetahuan secara pasif dari gurunya, tetapi membina pengetahuan melalui interaksi dengan persekitarannya (Kementerian Pelajaran Malaysia, 2001). Teori ini merupakan teori ketiga yang disandarkan dalam kajian ini. Ianya ditakrifkan sebagai suatu proses pembelajaran aktif, dimana pelajar membina satu pembelajaran baru berdasarkan pembelajaran yang diterima semasa dan sebelumnya berpandu pengalaman, latar belakang budaya dan sejarah seseorang pelajar (Hoover, 1996; Bruner, 1990). Guru pula hanya akan berperanan sebagai fasilitator dengan menyediakan keperluan dan persekitaran yang berupaya membantu pelajar meningkatkan kefahaman serta motivasi mereka (Clements, 1997; Hoover, 1996).

Seterusnya, pembelajaran konstruktivisme apabila diaplikasi dilaksanakan melalui penggunaan teknologi multimedia dilihat mampu mencetus inovasi baru dalam proses pengajaran dan pembelajaran (Mvuduu & Vurgess, 2012). Ianya menggalakan pembelajaran aktif berlaku dalam kalangan pelajar terutamanya semasa proses penerokaan sesuatu perisian multimedia (Pemberton, Fallahkhair & Masthoff, 2005). Hal ini dapat dikaitkan dengan animasi *talking-head,* yang berpontensi membantu pelajar mempertingkatkan prestasi sebutan yang betul melalui persembahan multimedia yang disampaikan. Ini kerana, melalui pembelajaran menggunakan animasi *talking-head,* pelajar mampu belajar secara aktif di mana-mana sahaja mengikut kadar kemampuan pembelajaran masing-masing tanpa bantuan guru secara kaedah tradisional (Massaro, 2005).

Bedasarkan tiga teori utama yang telah diperbincangkan, satu karangka konseptual kajian telah dibina seperti rajah 1.3

Berdasarkan kerangka konseptual yang dibina ini, pembelajaran animasi *talking-head* adalah lebih sesuai menggunakan pendekatan pembelajaran konstruktivisme. Ini adalah kerana, pendekatan pembelajaran aktif, yang ditekankan melalui pendekatan konstruktivisme akan memberi peluang kepada pelajar membina pengetahuan baru berdasarkan pengetahuan yang telah dipelajari sebelum ini. Selain itu, pelajar juga diberi kebebasan mempelajarinya secara kendiri mengikut kadar kemampuan pembelajaran masing-masing tanpa bantuan guru secara kaedah tradisional.



Rajah 1.3: Kerangka Konseptual Kajian

Peranan karektor dalam animasi *talking-head* ini amat signifikan. Ini bersandarkan kepada peranan karektor sebagai guru dalam menyampaikan maklumat bagaimana sesuatu perkataan itu dapat disebut dengan tepat oleh pelajar. Namun, kesilapan dalam pemilihan reka bentuk karektor yang bersesuaian terutamanya dari sudut tahap realistik akan menyebabkan berlakunya gangguan emosi ke atas pelajar. Menurut teori *Uncanny Valley*, reka bentuk karektor yang terlalu realistik akan memberi kesan mengerikan terhadap karektor tersebut. Hal ini dilihat akan menganggu tahap keselesaan dan emosi manusia. Berpandukan teori tersebut, tahap realistik karektor merupakan elemen utama yang perlu diberi keutamaan dalam mereka bentuk kerektor animasi *talking-head*, agar gangguan terhadap emosi pelajar dapat dielakkan dalam proses pembelajaran. Sehubungan itu, adalah penting kajian dijalankan bagi mengenalpasti tahap realistik yang bersesuaian bagi tujuan penggunaan *talking-head* untuk pembelajaran sebutan perkataan.

Seterusnya, animasi *talking-head* yang berperanan sebagai animasi instruksi di dalam proses pembelajaran sebutan, berupaya menyalurkan maklumat pembelajaran melalui kedua-dua saluran visual dan saluran verbal di dalam sistem memori. Saluran visual akan memproses maklumat reka bentuk karektor seperti ekspresi muka karektor dan pergerakan bibir karektor, manakala saluran verbal akan memproses maklumat teks dan audio yang disebut oleh karektor tersebut. Melalui penggunaan kedua-dua saluran ini, isu bebanan kognitif di dalam memori kerja dapat dikurangkan dan seterusnya model mental yang tepat dapat dibentuk di dalam memori kerja. Hasil daripada gabungan pengetahuan sedia ada yang dimiliki pelajar serta model mental yang dibina, akan membantu pembentukan skema yang sempurna untuk didaftar secara kekal di dalam memori jangka panjang. Dengan pembentukan skema yang sempurna, prestasi sebutan pelajar dapat dipertingkatkan bila mana skema tersebut diaktifkan apabila pelajar perlu menggunakan perkataan tersebut. Namun, menjadi persoalan, adakah model mental yang dibina di dalam memori kerja, ada sebarang pengaruh dari sudut emosi yang terhasil akibat tahap realistik sesuatu karektor animasi *talking-head*? Jika hal ini berlaku, pastinya impak yang berbeza akan wujud terhadap ketepatan sebutan pelajar berdasarkan perbezaan tahap realistik karektor animasi *talking-head*. Sehubungan itu, kajian ini akan mencari jawapan bagi persoalan-persoalan yang wujud dalam pembinaan kerangka konseptual.

RUMUSAN

Animasi *talking-head* merupakan animasi instruksi yang mampu membantu meningkatkan kemahiran komunikasi melalui peningkatan kemahiran sebutan sesuatu perkataan secara betul dan tepat. Hal ini terbukti melalui beberapa kajian yang menunjukkan bahawa penggunaan animasi yang dinamik adalah lebih baik berbanding pembelajaran yang dijalankan secara konvensional. Namun, kesilapan dalam pembangunan animasi instruksi akan memberi kesan negatif kepada pelajar. Oleh yang demikian, kajian ini akan memfokuskan kepada isu *uncanny valley* yang dikatakan memberi kesan kepada emosi pelajar. Ianya terjadi apabila karektor animasi tersebut hampir menyerupai manusia. Justeru itu, kajian ini akan menilai penggunaan animasi *talking-head* yang berbeza tahap realistik terhadap pembelajaran linguistik dalam kursus *English for Communication* di Kolej Komuniti. Penilaian penggunaan animasi ini akan diukur melalui prestasi sebutan dan emosi pelajar selepas mempelajari animasi ini secara kendiri. Tiga prototaip animasi *talking-head* dan satu prototaip *talking-head* menggunakan manusia sebenar dibangunkan untuk diuji dan digunakan oleh pelajar. Ini bertujuan untuk mengenalpasti kesan tahap realistik bagi setiap prototaip yang dibangunkan. Hasil daripada ujikaji yang dijalankan terhadap penggunaan animasi *talking-head* kelak akan memberi suatu syor kepada pembangunan animasi yang melibatkan penggunaan karektor animasi, supaya ianya memberi kesan yang maksimum kepada kepada peningkatan prestasi dan emosi pelajar.

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Mohd Najib Hamdan
Fakulti Seni, Komputeran dan Industri Kreatif
Universiti Pendidikan Sultan Idris
najib_kp@yahoo.com, +6016-2035863

Ahmad Zamzuri Mohamad Ali
Fakulti Seni, Komputeran dan Industri Kreatif
Universiti Pendidikan Sultan Idris
zamzuri@fskik.upsi.edu.my, +6012-4777395

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Kajian Rekabentuk dan Binaan Motor Arus Terus Magnet Kekal Tanpa Berus Pemutar Luar untuk Basikal Elektrik

Azhan Abdullah, Samila Mat Zali,
Mohd Saufi Ahmad & Dahaman Ishak

ABSTRAK

Hari ini basikal elektrik merupakan pilihan yang baik menggantikan pengangkutan mahal seperti motor dan kereta. Disamping itu juga, basikal elektrik merupakan kenderaan pilihan yang mampu mengurangkan pencemaran udara yang disebabkan oleh kebanyakkan kenderaan automotif dan industri. Motor elektrik merupakan bahagian terpenting dari sebuah basikal elektrik. Penyelidikan dan pembangunan motor elektrik merupakan proses yang berterusan bagi meningkatkan prestasi di samping meminimumkan saiz motor dan menghasilkan motor yang bersaiz kecil, ringkas dan ringan. Penyelidikan tesis ini adalah berkaitan kajian reka bentuk dan binaan motor 3 fasa jenis motor arus terus tanpa berus dengan magnet kekal. Ia direka khas untuk motor pemacu terus dengan kelajuan yang rendah. Motor yang direka bentuk mempunyai topologi pemutar di luar dengan aliran fluks berjejari yang digabungkan dengan bahan magnet kekal jenis neodymium-besi-boron. Sistem penghantaran motor dibuat tanpa gear dan ia mampu meningkatkan kecekapan motor di samping menggurangkan beratnya. Langkah awal prosedur ialah untuk menentukan kuasa perenjangan motor yang diperlukan untuk menggerakkan basikal. Parameter motor dihitung dengan menggunakan persamaan analitikal dengan beberapa andaian dibuat. Kaedah unsur terhingga digunakan untuk menganalisis pengagihan medan elektromagnet dalam rekabentuk motor dan mengesahkan pengiraan rekabentuk. Perisian analisa unsur terhingga yang digunakan dalam simulasi ini ialah perisian Opera2d. Tiga rekabentuk motor dengan kombinasi terbaik lubang alur per kutub telah dipilih iaitu 12 lubang alur dengan 10 kutub, 12 lubang alur dengan 14 kutub dan 12 lubang alur dengan 16 kutub. Simulasi telah dibuat terhadap ketiga-tiga rekabentuk tersebut menggunakan analisis unsur terhingga. Hasilnya dibentangkan serta dibandingkan. Perbandingan dibuat berdasarkan ciri-ciri elektromagnet dan prestasi motor seperti daya kilas pemungkahan, daya gerak elektrik balikan dan agihan fluks magnet. Keputusan simulasi menunjukkan rekabentuk motor dengan kombinasi 12 lubang alur dengan 14 kutub adalah yang terbaik kerana mempunyai nilai daya kilas pemungkahan yang rendah, mempunyai ketumpatan fluks yang tidak tinggi dan bentuk daya gerak balikan yang lebih trapezoidal di samping nilai voltan yang lebih tinggi terhasil. Seterusnya memenuhi kuasa dan daya yang diperlukan. Motor 12 lubang alur dengan 14 kutub ini akan dibangunkan sebagai motor prototaip dan diuji. Keputusan ujian akan ditunjukkan bagi menilai adakah ianya hampir sama seperti simulasi.

ABSTRACT

Today electric bicycle is a good choice to replace expensive transport such as motor and car. In addition, the electric bicycle is the vehicle options that could reduce air pollution caused by most automotive vehicles and industry. The most important parts of the Electric Motor of an electric bicycle. Electric motor research and development is an ongoing process to improve performance

as well as to minimize the size of the motor and the motor is small in size, simple and lightweight. Research of this thesis is related to the study design and construction 3 phase motor type direct current brush motor with permanent magnet without. It is specially designed for direct drive motor with low speed. Motor has designed topology outdoor player flux flows berjejari combined with permanent magnetic material of neodymium-iron-boron. Delivery system made without the gear motor and it can increase the efficiency of the motor as well as diminished its weight. The initial step is to define the procedures motor propulsion power required to move the bike. Motor parameters calculated using analytical equations with a set of assumptions made. Finite element method used to analyze the distribution of electromagnetic field in the motor design and verify design calculation. Finite element analysis software used in the simulation software Opera2d. Three motor design with the best combination of slot per pole has chosen 12 slot with 10 Poles 12 slot with 14 poles, and 12 slot with 16 pole. Simulation against three of the design using finite element analysis. The results are presented and compared. The comparison is made based on electromagnetic characteristics such as motor performance and cogging torque, intuitive electric magnetic flux distribution and back electromotive force. Results of the simulation showed motor design with a combination of 12 slot with 14 pole is the best because it has the low value of cogging torque have a high flux density is not intuitive and reverse more trapezoidal in addition to higher voltage value. Next meet the power and force is needed. Motor 12 slot with 14 pole motor will be developed as prototypes and tested. The test results will be shown for the evaluation is it almost the same as simulation.

PENGENALAN

Perkembangan sains dan teknologi masa kini, turut membawa perubahan di dalam bidang rekabentuk yang juga mempengaruhi bidang kejuruteraan dan sains. Perkembangan ini amat berkait rapat antara satu sama lain. Bidang sains menentukan ilmu pengetahuan asas manakala bidang kejuruteraan pula adalah penggunaan pengetahuan ilmu sains tersebut.

Pengetahuan terutamanya dalam bidang fizik dan matematik membolehkan ilmu tersebut digunakan secara praktikal dengan prinsip-prinsip mekanikal. Setiap idea rekabentuk yang diketengahkan mengambil kira faktor-faktor seperti pengendalian yang mudah, kelancaran perjalanan kerja dan memberikan pulangan yang maksimum ataupun kepuasan kepada pengguna. Faktor-faktor ini dititik beratkan agar pengguna mempunyai keyakinan terhadap sistem dan keupayaan sesuatu rekabentuk yang telah dihasilkan.

Sesuatu rekabentuk adalah ilham awal yang dilahirkan oleh seseorang dan kemudian ilham tersebut digambarkan di atas helaian kertas yang meliputi beberapa bentuk sudut pandangan. Idea ini seterusnya diperbaiki serta diberi ukuran dan saiz mengikut keperluan dan keadaan sesuatu bentuk projek. Keadaan mekanisma yang direka itu berfungsi mengikut sistem yang dicadangkan dan dilukis dalam bentuk lukisan kejuruteraan. Seterusnya idea tersebut disampaikan kepada umum dengan cara yang ringkas, jelas serta mudah difahami dan dalam bentuk yang menarik. Menurut [1]. " Model yang menarik dan menunjukkan ciri-ciri penggunaannya sudah tentu akan menarik minat sesiapa yang melihatnya."

Pada masa kini permintaan terhadap kenderaan elektrik kian berkembang dengan pesatnya. Ini berdasarkan kepada faktor harga minyak petrol yang kian meningkat dan banyak negara mencari alternatif lain selain daripada bergantung kepada kenderaan berenjin petrol dan diesel.

Basikal elektrik merupakan kenderaan elektrik jenis ringan dan salah satu pilihan terbaik pengguna untuk beralih ke kenderaan elektrik. Basikal elektrik bukan sahaja ringan tetapi senang dibawa malah harga dipasaran juga murah jika dibandingkan dengan kenderaan automotif yang lain. Kos operasi juga hampir tiada disebabkan oleh basikal elektrik memerlukan kerja penyelenggaraan yang sangat minimum. Kebanyakkan Negara termasuk Malaysia, basikal elektrik tidak memerlukan insuran atau lesen. Penggunaan kenderaan elektrik ini mampu mengurangkan pencemaran udara yang disebabkan oleh asap kenderaan automotif dan industri. Basikal elektrik merupakan kenderaan mesra alam dan menjimatkan. Disamping itu ia mudah dibawa dan pengguna tidak perlu bimbang tentang kesesakkan lalu lintas. Walau bagaimanapun, penggunaan kenderaan ini amat terhad kerana ia sesuai digunakan untuk perjalanan jarak dekat dan sangat sesuai untuk tujuan rekreasi [2].

Rekabentuk motor pada basikal elektrik adalah satu bidang penting untuk meningkatkan prestasi, kecekapan dan mengurangkan kos. Fokus utama dalam projek ini ialah merekabentuk motor bagi basikal elektrik pemacu terus jenis kelajuan rendah. Motor yang dipilih ialah jenis motor arus terus magnet kekal yang

Pemilihan berdasarkan kos yang rendah, kebolehpercayaan yang tinggi, dengan teknik fabrikasi yang mudah. Rekabentuk motor dengan konfigurasi rotor diluar adalah bersesuaian untuk di pasang pada roda basikal supaya dapat mencapai daya kilas yang tinggi, stabil dan sesuai untuk operasi kelajuan rendah.

Terdapat pelbagai jenis basikal elektrik yang terdapat dipasaran yang mempunyai kuasa dari 150 Watt sehingga 500 Watt. Basikal Ini dibezakan dari segi spesifikasi atau jarak prestasi yang bergantung kepada kegunaaan penunggang. Basikal yang berbeza spesifikasi bergantung kepada kegunaan samada di bandar, kawasan pendalaman yang berbukit, perjalanan jarak jauh dan juga basikal untuk berlumba. Untuk kegunaan di bandar prestasi basikal memerlukan pecutan yang laju dan kekerapan untuk berhenti. Kuasa purata jenis basikal ini ialah 150 Watt dan kelajuan purata perlulah mencapai 17.6 km/j. Basikal elektrik jenis kawasan berbukit perlulah mempunyai keupayaan daya kilas yang tinggi dan mampu mempunyai kuasa maksimum 300 Watt pada kelajuan 12.8 km/j pada masa yang cepat dan kawasan berbukit adalah dianggarkan mencapai 4% kecuraman cerun. Basikal jenis jarak jauh biasanya direkabentuk khas untuk perjalanan yang jauh dan panjang dengan kelajuan yang agak perlahan dan malar. Purata kelajuan bagi basikal jenis ini ialah 16 km/j dengan purata kuasa 100 Watt. Pusingan kitaran yang lain bagi basikal ialah basikal jenis memecut [3]. Basikal jenis ini biasanya mempunyai keupayaan dan kelajuan yang tinggi. Ianya boleh beroperasi sehingga kelajuan 20 km/j dengan kuasa perata 200 Watt. Menjadi kelaziman rekabentuk basikal yang bergantung kepada satu-satu jenis operasi pusingan atau keperluan kuasa tertentu lebih efisien, mampu mengurangkan berat, kos dan meningkatkan kualiti motor [4].

Teknologi motor hab membawa kepada perkembangan pemacu yang kian mendapat tempat dalam rekabentuk basikal elektrik iaitu pemacu terus. Pemacu jenis ini tidak memerlukan sebarang elemen menghubungkan tayar sebaliknya motor dipasang terus pada tayar samaada tayar depan atau belakang. Pemacu terus adalah tanpa gear antara kebaikan pemacu jenis ini ialah menghapuskan gear mekanikal, tidak lagi memerlukan sebarang pelincir, menggurangkan sistem yang kompleks dan menghilangkan hingar akustik [5]. Pemacu jenis ini lazimnya sesuai untuk motor jenis kelajuan rendah, daya kilas tinggi dan mempunyai kecekapan mekanikal yang tinggi.

Hab motor adalah salah satu motor yang digunakan pada tayar yang menggunakan aplikasi pemacu terus. Hab motor merupakan, rekabentuk yang banyak digunakan dalam rekabentuk basikal elektrik masa kini. Motor jenis ini dibina dengan kos yang agak tinggi disebabkan struktur motor yang rumit berbanding motor jenis lain. Jenis hab motor ini biasanya lebih besar dan berat berbanding motor lain yang mempunyai kuasa keluaran yang sama. Walaubagaimanapun hab motor tetap menjadi pilihan disebabkan oleh kecekapan motor tinggi dan menjimatkan ruang. Motor jenis ini sesuai untuk basikal jenis kelajuan rendah . Hab motor terbahagi kepada dua jenis iaitu motor dengan berus dan motor tanpa berus.

Motor dengan berus masih terdapat dipasaran disebabkan kawalan yang ringkas berbanding motor tanpa berus iaitu kawalan kelajuan, melalui kawalan arus armatur dan penukar statik kuasa yang rendah kos [6]. Disebalik kos yang rendah pada kawalan motor, motor ini memerlukan kos penyelenggaraan yang tinggi, hinggar elektrik yang tinggi, jangka hayat yang kurang dan kecekapan yang kurang berbanding motor arus terus tanpa berus[7][8]. Motor tanpa berus merupakan motor tanpa penyelenggaraan berus dan menggantikan aplikasi berus dengan pensuisan elektronik. Kelebihan motor ini ia banyak digunakan dalam aplikasi kenderaan elektrik. Motor yang diklafikasikan dalam keluarga motor tanpa berus ini ialah motor aruhan, motor engganan tersuis, motor segerak magnet kekal dan motor tanpa berus arus terus dengan magnet kekal. Motor aruhan lebih murah berbanding motor tanpa berus jenis lain disebabkan teknologi motor ini telah matang dari segi pembuatannya disamping pengeluaran tinggi terhadap permintaan yang tinggi tetapi mempunyai kelemahan dari segi kehilangan yang tinggi pada pemutar dan memerlukan sisitem kawalan yang agak rumit. Binaan motor yang ringkas dan lasak menyebabkan motor engganan tersuis makin menonjol dalam aplikasi kenderaan elektrik. Walau bagaimanapun bentuk tidak rata atau tertonjol pada motor jenis ini menjurus kepada masalah riak kilas yang kritikal dan ia juga membawa kepada getaran dan tahap hinggar yang tinggi. Dengan itu motor engganan tersuis memerlukan penukar yang istimewa dan litar kawalan yang mempunyai mikropemproses yang kompleks menambahkan kos pada sistem motor.

Perkembangan motor tanpa berus serentak dengan perkembangan magnet kekal bertenaga tinggi menjadikan motor arus terus magnet kekal menjadi tumpuan. Kelebihan menggunakan magnet kekal ialah ia mempunyai sifat pengujaan yang tinggi dan jangka hayat yang pangjang. Magnet bumi yang biasa digunakan ialah ferrites, samarium cobalt (SmCo) dan neodymium besi boron (NdFeB). Harga yang berpatutan, tinggi sifat kebakian dan kepaksaan, yang menyebabkan neodymium besi boron (NdFeB) menjadi pilihan dalam kebanyakkan motor. Motor magnet kekal menghapuskan kehilangan tembaga pada pemutar membawa kepada prestasi motor yang tinggi dan ketumpatan kuasa yang tinggi. Secara amnya motor magnet kekal tanpa berus diklasifikasikan kepada dua jenis iaitu motor segerak magnet kekal dan motor arus terus magnet kekal. Perbezaan utama kedua-dua jenis ini ialah gelombang yang dibekalkan pada pemegun. Kehadiran penderia resolusi tinggi meyebabkan motor segerak lebih mahal berbanding motor magnet kekal arus terus tanpa berus yang mempunyai litar kawalan yang ringkas[9].

Berbanding motor yang lain motor arus terus dengan magnet kekal tanpa berus menjadi pilihan dalam rekabentuk disebabkan kecekapan motor yang tinggi dan tinggi ketumpatan daya kilas[10]. Disamping itu, motor ini juga mempunyai litar kawalan yang ringkas dan dapat mengurangkan kos keseluruhan sistem berbanding motor tanpa berus yang lain.

KEUPAYAAN BASIKAL ELEKTRIK

Proses rekabentuk motor yang sistematik amat penting dalam membantu penyelidik memahami keperluan rekabentuk dan spesifikasi untuk mendapatkan hasil rekabentuk yang efektif disamping menjimatkan masa. Rekabentuk motor a.t. dengan magnet kekal tanpa berus ini bermula dengan memahami konsep asas prestasi basikal elektrik. Spesifikasi atau julat prestasi basikal elektrik ialah kitar pengendalian basikal samada digunakan untuk bandar, kawasan berbukit, perjalanan jarak jauh atau basikal kelajuan tinggi. Kelajuan maksimum dan kuasa yang diperolehi berdasarkan parameter penunggang basikal adalah amat penting dalam merekabentuk sistem pemacu elektrik untuk basikal. Rekabentuk yang dipilih dalam projek ini ialah basikal kelajuan rendah yang sesuai untuk beroperasi di bandar dan kawasan yang tidak berbukit. Rekabentuk juga masih mengekalkan kayuhan pada basikal untuk mengurangkan kuasa, kos binaaan dan saiz motor. Pengiraan kasar prestasi dan julat kelajuan basikal diperolehi penting dalam pengiraan dimensi dan pensaizan motor.

Proses seterusnya ialah memahami konsep sistem pemacu motor a.t. dengan magnet kekal tanpa berus yang menghasilkan daya gerak elektrik balikan yang berbentuk trapezoid dan memerlukan arus segiempat tepat untuk memastikan basikal elektrik bergerak dengan baik.

Proses pemilihan lain yang penting dalam rekabentuk motor ialah pemilihan bilangan nombor kutub dan lubang alur yang bergantung kepada keperluan pada aplikasi basikal elektrik. Setelah lengkap proses pemilihan, langkah seterusnya ialah pendimensian dan pensaizan motor berdasarkan ciri-ciri dan spesifikasi yang diperolehi. Pensaizan merupakan analisis yang kompleks dan pengiraan analitikal secara amnya dimulakan dengan beberapa andaian. Berdasarkan nilai kuasa dan daya kilas yang dikira, pensaizan dan pendimensian motor dapat ditentukan dan diterangkan dalam bab ini.

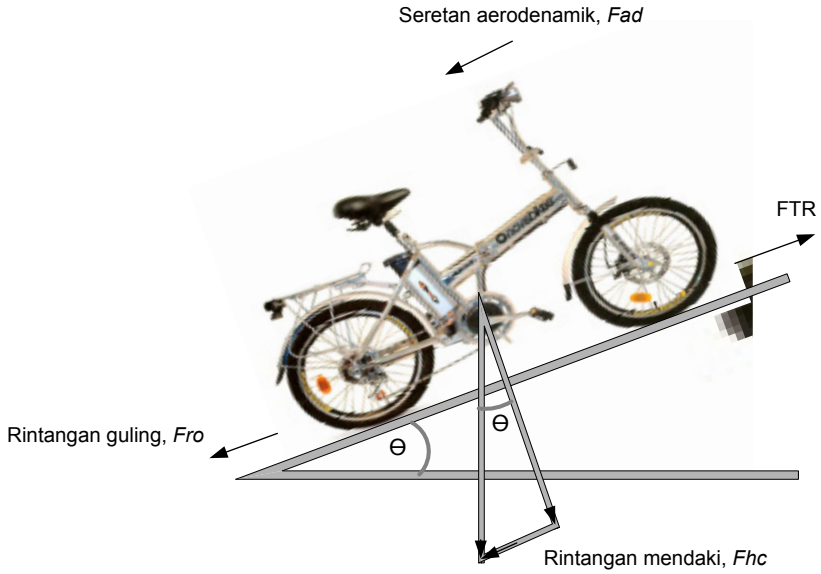
A. Cirian Beban Jalan

Prestasi basikal elektrik bergantung kepada beberapa faktor yang penting antaranya ialah berat basikal, graviti, keadaan jalan, keadaan angin dan permukaaan tayar dalam menentang geseran guling. Oleh itu basikal memerlukan motor yang cukup kuasa untuk mengatasi faktor-faktor tersebut dan menggerakan penunggang ke hadapan. Ciri pertama dalam menentukan prestasi basikal ialah daya tarikan, F_{TR}. Daya tarikan, F_{TR} daya yang diperlukan untuk basikal bergerak ke hadapan dan mengatasi rintangan beban jalan. Daya beban jalan, F_{RL} yang bertindak ke atas kenderaan secara amnya dapat dilihat melalui persamaan 1.

$$F_{RL} = f_{hc} + f_{ad} + f_{ro} \quad (1)$$

Jumlah beban jalan terdiri daripada:

f_{hc} - Daya mengatasi rintangan mendaki bukit
f_{ad} - Daya mengatasi tarikan aerodinamik
f_{ro} - Daya mengatasi rintangan guling



Rajah 1: Daya yang bertindak ke atas basikal untuk bergerak di cerun jalan

B. Rintangan Mendaki

Rintangan ketika mendaki cerun atau bukit (f_{hc}) mempunyai tanda operasi positif dan daya apabila menuruni bukit (f_{hc}) mempunyai tanda negatif dan persamaan daya dapat dilihat melalui persamaan 2.

$$f_{hc} = \text{m. g. Sin } \theta \qquad (2)$$

Di mana:

m - Jumlah berat basikal
g - Daya graviti
θ - Sudut gred cerun

C. Seretan Aerodinamik

Seretan aerodenamik ialah geseran yang terjadi antara basikal ketika bergerak melalui udara. Persamaan bagi formula daya ini ialah:

$$Fad = \frac{Cd \,.\, \rho \,.\, A \,.\, vr^{\,2}}{2} \qquad (3)$$

Di mana :

Cd - Pekali seretan
A - Luas depan
ρ - Ketumpatan udara
Vr - Kelajuan relative di udara dan merupakan kombinasi kelajuan udara, vw dan kelajuan permukaan, vg. Persamaan untuk vr ialah:

$$Vr = Vg + Vw \qquad (4)$$

Nilai pekali seretan, Cd boleh dikurangkan melalui bentuk fizikal basikal dan keadaaan penunggang ketika berbasikal. Dalam kebanyakkan kes, nilai pekali seretan berbeza mengikut kedudukan penunggang. Bagi penunggang postur yang hampir rebah, nilai pekali seretan ialah 0.77 dan penunggang basikal yang postur tegak ialah 1. Ketumpatan udara adalah berbeza mengikut ketinggian dari paras laut, suhu dan kelembapan. Luas depan pada basikal merangkumi penunggang dan luas hadapan basikal dan biasanya nilainya ialah 0.4meter persegi [11].

D. Rintangan Guling

Rintangan guling (f_{ro}) disebabkan oleh berat kenderaan dan geseran tayar pada permukaan jalan [12]. Persamaan bagi formula daya ini ialah:

$$f_{ro} = Crr \,.\, m \,.\, g \tag{5}$$

Di mana :

m - Jumlah berat basikal
g - Daya graviti
Crr - Pekali guling yang bergantung kepada tekanan tayar dan jenis tayar basikal.

Contoh persamaan bagi pekali guling ialah:

$$Crr = A + \frac{B}{W} \tag{6}$$

Di mana :

W - Berat dalam paun
A - Nilai pemalar – 0.0031 (Bagi basikal 2 tayar yang mempunyai 35 psi tekanan udara dalam tayar)
B - Nilai pemalar – 0.75 (Bagi basikal 2 tayar yang mempunyai 35 psi tekanan udara dalam tayar)

E. Penskalaan keperluan kuasa Jalan dan Kadaran Kuasa Motor

Berdasarkan cirian beban jalan, kuasa diperlukan untuk memacu tayar basikal bergerak kepada kelajuan yang dikehendaki. Kuasa jalan meliputi kuasa yang berjaya menentang rintangan graviti ketika mendaki, menentang kerintangan tayar ketika tayar berguling dijalan dan menentang rintangan udara atau aerodinamik ketika bergerak melalui udara. Antara parameter yang penting dalam menentukan kuasa basikal ialah kelajuan tayar, berat penunggang dan basikal, nilai kecerunan dan kelajuan angin. Kuasa jalan yang diperlukan dapat diringkaskan melalui persamaan berikut:

$$P = F_{TR} \,.\, v_g \qquad \text{(Watt)} \tag{7}$$

$$v_g = \omega \,.\, r_w \tag{8}$$

Di mana :

FTR - Daya tarikan dalam Newton
vg - Kelajuan dalam meter per saat
rw - Jejari tayar dalam meter.

Persamaan dinamik apabila basikal bergerak ialah :

$$F_{TR} - F_{RL} = m \cdot \frac{dv}{dt} \quad (9)$$

Apabila basikal dalam keadaan kelajuan tetap, dv/dt menghampiri sifar maka jumlah daya juga sifar. Perejangan kuasa ketika keadaan ini merupakan kuasa yang diperlukan untuk mengatasi kerintangan jalan dan tiada pecutan berlaku. Kuasa tarikan pada basikal ialah kuasa ialah kuasa yang diperlukan untuk mengatasi kerintangan pada jalan. Untuk menentukan kadaran kuasa pada motor, nilai kuasa yang dikira perlulah mengambil kira kehilangan mekanikal dan elektrikal ketika motor berputar. Sebagai permulaan dalam mendapatkan kuasa yang diperlukan bagi motor basikal elektrik. Kuasa jalan perlu dikira dengan beberapa andaian dibuat seperti berikut:

i. Kelajuan relatif angin adalah sifar
ii. Basikal mempunyai halaju malar iaitu tidak memecut
iii. Kuasa masukan pada pengayuh ialah rentapan pada tayar belakang yang merupakan titik sentuh pada seretan aerodinamik.

Dengan menganggarkan jumlah berat beban ialah 80 kg (terdiri daripada jumlah berat penunggan, berat basikal dan berat barang yang dibawa) dan kelajuan maksimum yang dicapai ialah 20 kilometer per jam, penggunaan kuasa maksimum pada permukaan jalan dapat ditentukan. Jadual 1 menunjukkan parameter pada penunggang untuk menentukan penggunaan kuasa jalan.

Jadual 1: Parameter-parameter pada basikal

Bil	Perkara	Nilai
1	Luas Hadapan, A	0.40 m^2
2	Pekali Seretan Aerodinamik, Cd	1.00
3	Ketumpatan Udara, ρ	1.197 kg/m^3
4	Berat Basikal dan Penunggang, m	80.00 kg
5	Pekali Guling, Crr	0.007
6	Kecuraman, θ	0 – 2%
7	Jejari Tayar, r_w	0.66 m

Berdasarkan parameter-parameter dua kes telah dibuat kajian dan keputusannya disimpulkan seperti berikut:

Kes 1 :

Dengan berat 80 kg, daya aerodinamik yang terhasil pada permukaan jalan yang rata, Kecerunan 0% ialah 6.8 N manakala daya guling ialah 4 N. Jumlah daya tarikan ialah 11.8 N. Pada jejari tayar 0.66m daya kilas yang diperlukan untuk memutarkan tayar ialah 3.894 Nm. Kuasa yang diperlukan untuk memacu kelajuan motor 200 pusingan per minit ialah 81.38 W.

Kes 2 :

Apabila basikal melalui kecerunan jalan 2%, daya untuk mengatasi kerintangan mendaki bukit ialah 16 N, daya seretan aerodinamik ialah 6.8 N manakala rintangan guling ialah 4 N. Jumlah maksimum daya tarikan dalam kes ini ialah 26 N. Daya kilas yang terhasil pada diameter tayar 0.66m ialah 8.58Nm. Kuasa untuk basikal berputar pada ketika kelajuan basikal 20.9 rad/saat ialah 180 W.

PARAMETER REKABENTUK MOTOR

Tiga rekabentuk motor jenis alur berperingkat yang dipilih untuk penyelidikan bagi tujuan perbandingan prestasi ialah 12-lubang alur dan 10-kutub, 12-lubang alur dan 14-kutub dan 12-lubang alur dan 16-kutub. Ketiga-tiga reka bentuk mempunyai binaan yang sama dari segi jejari luar pemutar, mempunyai ketebalan magnet yang sama dan mempunyai panjang sela udara yang sama. Terdapat perbezaan dari segi jejari dalam pemutar.

Ketiga-tiga parameter rekabentuk yang telah dikira dapat dilihat dalam Jadual 2.

Jadual 2: Parameter Motor

Dimensi Geometri	Motor 1 12-Lubang Alur 10-Kutub	Motor 2 12-Lubang Alur 14-Kutub	Motor 3 12-Lubang Alur 16-Kutub
Pemutar			
Jejari Pemutar Luar (mm), R_{ro}	60	60	60
Ketebalan Besi Belakang Pemutar (mm), W_{rbi}	8	7	7
Magnet Kekal			
Neodymium Besi Boron (NdFeB)			
- Ketebalan (mm), L_m			
- Sudut Magnet (darjah)	3	3	3
	31	29	27
Sela Udara (mm), L_g	1	1	1
Pemegun			
Jejari Pemegun Luar, R_{so}	47	49	49
Lebar Gigi, W_{tb}	10.4	11	11
Besi Belakang Pemegun, W_{bi}	10	13	13.5
Panjang Paksi, L	60	60	60
Jejari aci, R_s	7	7	7

DATA MASUKAN

Rekabentuk motor yang dipilih untuk analisa ialah motor 3 fasa a.t. tanpa berus dengan pemutar luar. Pemutar mempunyai bentuk magnet kekal segmen membulat dengan pemagnetan secara berjejarian, bahan magnet NdFeB dan pemegun mempunyai tatarajah belitan dua lapis. Proses memasukkan data dalam aplikasi prapemrosesan boleh dikategorikan kepada parameter mekanikal, elektrikal dan magnet.

1. Parameter Mekanikal

Parameter ini merupakan geometri rekabentuk motor yang dilukis menggunakan perisian AutoCAD yang mengandungi parameter mekanikal secara spesifik seperti garispusat bagi pemegun dan pemutar, ketebalan gelang yok pemegun dan pemutar, kedalaman lubang alur, ketebalan lubang alur, tinggi gigi, ketebalan magnet dan panjang sela udara. Nilai ini diperolehi dari parameter yang dikira secara analitikal bagi ketiga-tiga rekabentuk motor iaitu dari Jadual 2 dan setiap rekabentuk motor mempunyai diameter sela udara yang berbeza dan mempunyai diameter pemutar yang sama iaitu 120mm.

2. Parameter Elektrik

Parameter meliputi ciri-ciri elektrik motor iaitu bilangan kutub magnet, panjang pengalir per belitan, bilangan belitan pengalir setiap fasa dan faktor peratusan pengisian pengalir per lubang alur, voltan masukan a.t. , arus bekalan dan kadaran kelajuan.

3. Parameter Magnet

Parameter merangkumi ciri magnet atau lengkuk BH bagi bahan magnet kekal jenis NdFeB dan ciri lapisan berlamina keluli silikon. Rajah 4.1 menunjukkan Graf BH bagi lapisan keluli dan graf bagi magnet kekal jenis NdFeB.

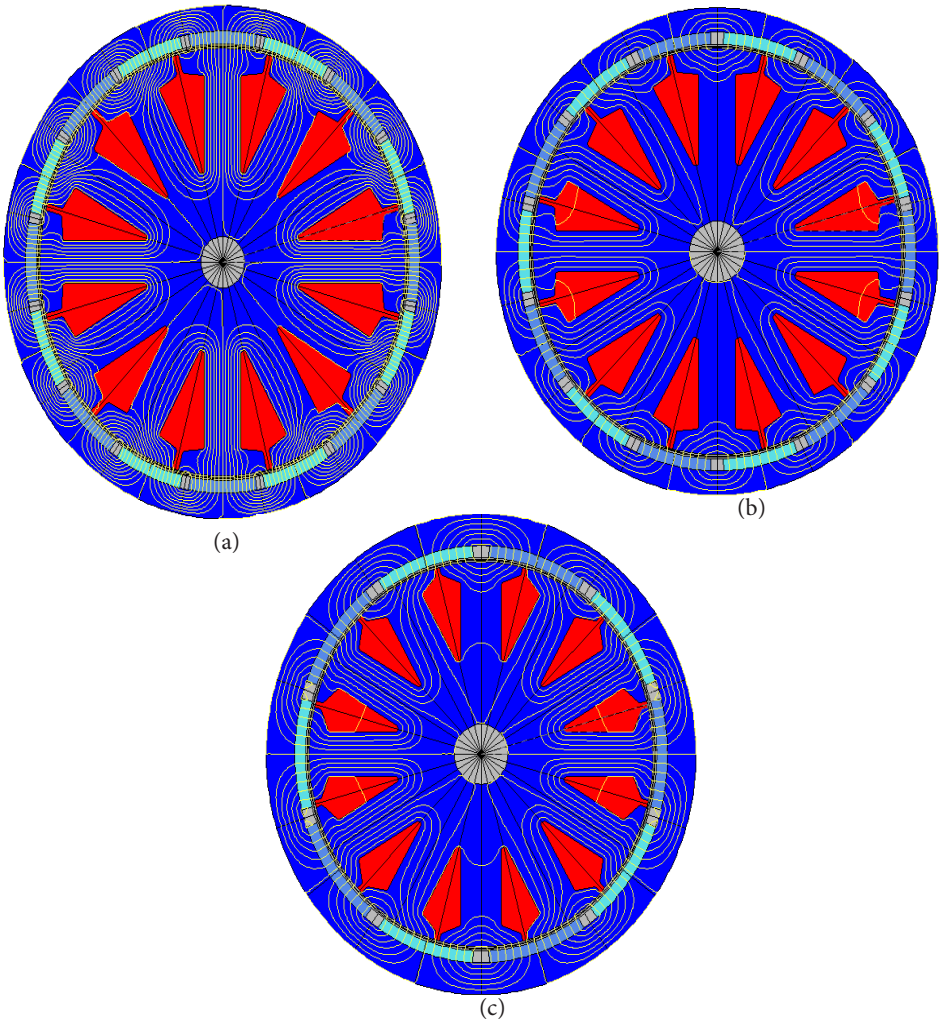
KEPUTUSAN ANALISA UNSUR TERHINGGA

Analisa statik dalam opera2d ialah untuk mencari agihan medan magnet. Analisa berlaku dalam keadaan litar buka atau tiada pengujaan arus dan daya kilas yang terhasil dalam keadaan ini dikenali sebagai daya kilas pemungkahan. Analisa dinamik meliputi sifat dinamik atau putaran motor apabila dimasukkan arus atau litar luaran. Analisa ini meliputi kuasa dan daya kilas elektromagnet.

A. Agihan Fluks

Ketumpatan fluks boleh diperolehi dari medan magnetostatik menggunakan simulasi Opera2d. Agihan garisan fluks medan magnet semasa litar buka bagi 12-lubang alur dan 10-kutub, 12-lubang alur dan 14-kutub dan 12-lubang alur dan 16-kutub dapat dilihat seperti Rajah 2. Agihan fluks yang dilihat pada pemegun dan pemutar yang melalui sela udara menunjukkan motor berfungsi dengan sela udara yang tepat.

Berdasarkan perisian analisa unsur terhingga kontur ketumpatan fluks bagi ketiga-tiga model dapat dilihat dalam Rajah 3. Nilai ketumpatan bagi semua bahagian motor adalah nilai penting dalam rekabentuk motor disebabkan nilai maksimum ketumpatan fluks setiap bahagian adalah berbeza. Berdasarkan rekabentuk pemegung yang berlubang alur nilai fluks pada gigi mempunyai had ketumpatan fluks 1.6 Tesla dan nilai berlebihan akan menyebabkan arus pemagnet dan kehilangan besi akan menjadi berlebihan. Nilai fluks maksimum yang diperolehi bagi 12-lubang alur dan 10-kutub ialah 1.83 Tesla, 12-lubang alur dan 14-kutub ialah 1.64 Tesla dan 12-lubang alur dan 16-kutub ialah 1.57 Tesla.



Rajah 2: Agihan Garis Fluks semasa litar buka. a) 12-lubang alur dan 10-kutub, b) 12-lubang alur dan 14-kutub dan c)12-lubang alur dan 16-kutub

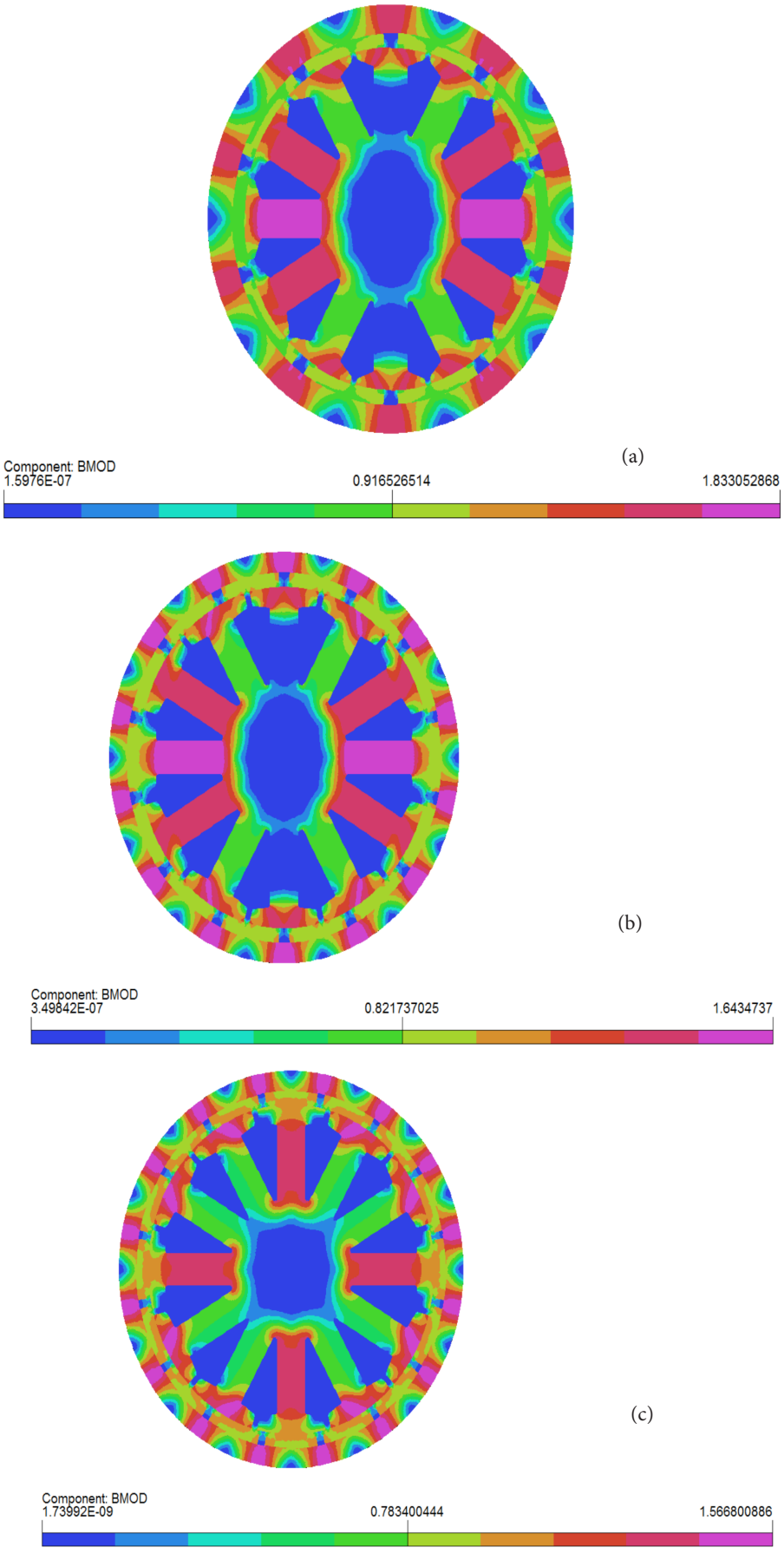
B. Ketumpatan Fluks Sela Udara

Berdasarkan gambarajah kontur iaitu Rajah 4.3 sela udara pada diameter setiap motor warna kuning dan oren menunjukkan ketumpatan fluks sela udara dalam linkungan 0.82. Nilai purata ketumpatan fluks pada sela udara B_g dapat dianggarkan melalui pengiraan teori melalui persamaan:

$$B_g = \frac{B_r}{1 + \frac{\mu_r . l_g}{l_m}}$$

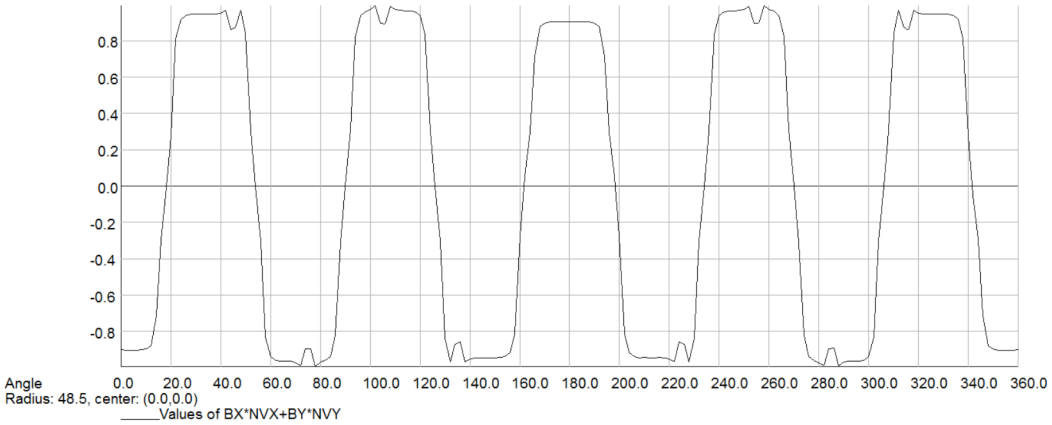
Dimana :

B_r - Kebakian magnet
μ_r - Kebolehtelapan magnet
l_g - Ketebalan sela udara
l_m - Ketebalan Magnet

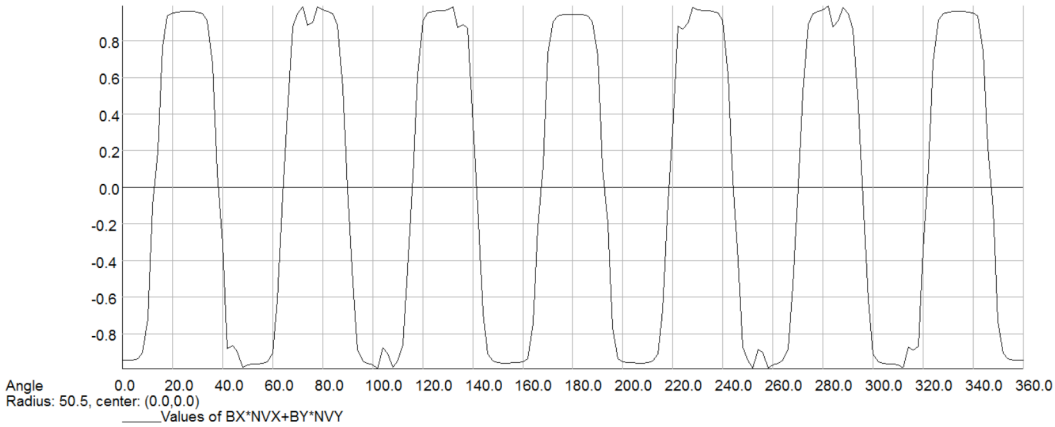


Rajah 3: Kontur ketumpatan fluks semasa litar buka a) 12-lubang alur dan 10-kutub, b) 12-lubang alur dan 14-kutub dan c)12-lubang alur dan 16-kutub

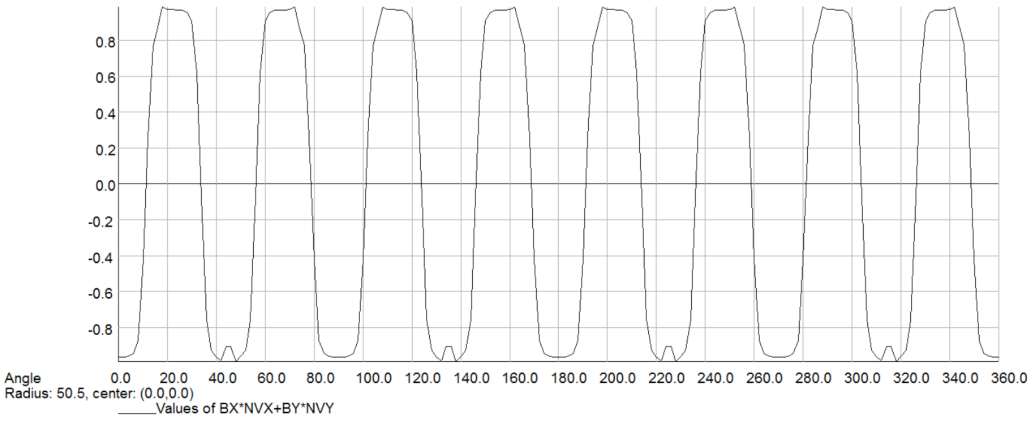
Berdasarkan persamaan , nilai purata yang diperoleh melalui rekabentuk motor ini ialah 0.84T. Rajah 4 menunjukkan gambarajah gelombang komponen jejari ketumpatan fluks pada sela udara pada jejari 48.5mm bagi 12-lubang alur dan 10-kutub dan jejari 50.5mm bagi 12-lubang alur dan 14-kutub dan 12-lubang alur dan 16-kutub. Keputusan simulasi Opera2d adalah ketika litar dalam keadaan buka. Dalam keputusan yang ditunjukkan ketumpatan fluks maksimum 0.78 hingga 0.91 T dan nilai adalah sama dengan pengiraan.



(a) 12-lubang alur dan 10-kutub



(b) 12-lubang alur dan 14-kutub



(c) 12-lubang alur dan 16-kutub

Rajah 4: Fluks disela udara yang terhasil pada pasangan 2 kutub semasa litar buka untuk 3 motor terpilih

KESIMPULAN

Rekabentuk motor magnet kekal tanpa berus secara amnya bermula dengan pengiraan asas prestasi basikal pada cirian beban jalan yang meliputi kerintangan ketika mendaki bukit, seretan aerodinamik dan kerintangan guling. Nilai kuasa jalan yang merupakan kuasa untuk memacu tayar bergerak dan berdasarkan gred cerun jalan yang berbeza. Keputusan kuasa jalan dibentangkan untuk menentukan kadaran kuasa pada rekabentuk.

Proses diteruskan dengan rekabentuk awal dengan nilai-nilai spesifikasi yang sedia ada dan pemilihan awal yang penting dalam rekabentuk. Perbezaan utama antara rekabentuk sedia ada iaitu topologi jenis pemutar luar bagi aplikasi basikal elektrik dapat dikategorikan kepada 3 perkara penting iaitu spesifikasi, bilangan lubang alur per kutub dan saiz motor. Pemilihan prototaip adalah untuk spesifikasi motor dengan bateri berkadaran 36V dan kelajuan rendah 200 putaran per minit dan saiz dimensi panjang 60mm dan diameter pemutar 120mm. Diameter yang kecil dapat menjimatkan penggunaan ruang pada basikal dan mengurangkan berat basikal. Tiga kombinasi motor yang dipilih iaitu 12-lubang alur dan 10-kutub, 12-lubang alur dan 14-kutub dan 12-lubang alur dan 16-kutub mampu menghasilkan daya kilas yang tinggi, riak yang rendah dan daya kilas pemungkahan yang rendah.

Analisis dan simulasi menggunakan perisian unsur terhingga, Opera2d mengesahkan kombinasi 12-lubang alur dan 14-kutub lebih sesuai dibina prototaipnya disebabkan oleh ciri elektromagnet yang lebih baik, daya kilas pemungkahan yang rendah, d.g.e balikan yang lebih trapezoidal dan nilai maksimum d.g.e balikan yang lebih tinggi untuk menghasilkan putaran yang licin dan daya kilas yang tinggi.

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Azhan Abdullah[1], Samila Mat Zali[2], Mohd Saufi Ahmad[3] & Dahaman Ishak[4]
Pusat Pengajian Kejuruteraan Sistem Elektrik,
Universiti Malaysia Perlis, Kampus Pauh Putra, 02600 Arau, Perlis.
azhanrau@yahoo.com[1]
samila@unimap.edu.my[2]
Saufi.ahmad@gmail.com[3]
dahaman@eng.usm.my[4]

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The Odour Threshold Test, A Tool for Odour Assessment: Preliminary Observations

Nastaein Qamaruz Zaman, Ros Nadiah Rosli &
Nurashikin Yaacof

ABSTRACT

There are few sources that contribute to odour surrounding Universiti Sains Malaysia, USM (Engineering Campus). This paper will investigate the possible sources within 2km and sampling techniques required for the sources. It is then being analysed in our lab using the Odour Threshold Test (OTT); a method that adapted from Japan. The main concerned is regarding the sampling and analysis technique that may be different from the one that is currently being used in Malaysia which is olfactometer. Results obtained from the laboratory test are compared with some examples from other researchers and it is proven to be correct. All sampling and analysis techniques including errors are discussed in this paper.

Keywords: odour, Triangle Bag Method, odour Malaysia

ABSTRAK

Terdapat beberapa punca yang menyumbang kepada masalah bau di sekitar Universiti Sains Malaysia, USM (Kampus Kejuruteraan). Makalah ini bertujuan mengenalpasti beberapa punca bau dalam lingkungan 2km dan teknik yang diperlukan semasa persampelan. Sampel bau tersebut telah dianalisis di makmal menggunakan *"Odour Threshold Test" (OTT);* kaedah yang diubahsuai daripada Jepun. Penumpuan diberikan kepada kaedah persampelan dan analisis yang mungkin berbeza seperti yang digunakan di Malaysia iaitu Olfaktometer. Hasil yang diperolehi daripada makmal dibandingkan dengan hasil yang diperoleh penyelidik sebelum ini dan ia terbukti benar. Kesemua kaedah persampelan dan analisis termasuk ralat dibincangkan dalam makalah ini

Kata kunci: bau, *"Triangular Bag Method"*, bau di Malaysia

INTRODUCTION

Many countries around the world are measuring the odour concentration using human olfaction. There are various methods for measuring the odour concentration and odour index; such as Olfactometer, Scentometer and Triangular Odour Bag method (JAOE, 2008). Currently in Malaysia, the standard olfactometry is being used to analyse odour samples. The instrument is expensive, requires regular maintenance, and highly trained operators to conduct the operation. Malaysia had come out with standard MS1963:2007 (Department of Standards Malaysia, 2007) for determination of odour concentration by dynamic olfactometry. The Malaysian standard is

corresponding to EN 13725:2003 (CEN, 2003) by the European. For this method, olfactometry is used to dilute the sample automatically with minimum 4 assessors. The instrument is using "Forced choice mode" where the assessor need to make decisions about the presence of odour by pressing the "Guess", "Inkling" or "Certain" button. After all assessors agreed with dilution and get them correctly, the dilution process will be stopped and the odour concentration is calculated automatically. To become the assessor, they have to pass the panel screening at standard deviation less or equal to 2.3 by using n-butanol.

Meanwhile in Japan, a regulation based on "odour index" has been added to the Offensive Control Law in 1995 (JAOE, 2008). The Triangular Odour Bag method is widely used at the country, where the experimental setup is cost effective and easy to conduct. However, they needed at least six assessors who must pass all the standard reference chemicals to analyse the odour. In this method, the dilution is prepared manually by using glass syringe. Three odour bags are prepared by inserting odourless gas and one of the bags is diluted with the odorant. The bags are passed to assessors and they need to choose a bag that contains different smell. After collecting all answers from assessors, the calculation is made and finally a result in term of odour concentration is obtained.

Odour normally is expressed in terms of odour concentration or odour index. Odour concentration is actually a dilution at which the sample is diluted until the odour cannot be distinguished or detected. However in Japan, the "odour index" is set up on basis values by multiplying the common logarithm by 10 so that the odour index becomes closer to the human senses than odour concentration. In the other hand, the European is using a scale called "odour levels" for their standard. The concept is same with the "odour index" from Japanese (JAOE, 2008).

There are some complaints regarding odour emissions in 2006 reported by Department of Environment, DOE (Othman et al., 2007). Most complaints come from the animal based (13%), follow by chemical industry (11%), rubber based (9%), municipal solid waste (9%), waste water treatment (8%), palm oil related (2%), and other industries related including housing and small shops. From the statistic, it shows that animal based contribute to the highest percentage for odour complaint in Malaysia. To check the odour concentration emission released from each source, is quite difficult, due to the lack of available olfactometers and the high costs of sample analysis. Therefore, a research is commissioned to adapt the Japanese and European method to suit the local conditions. The objective is to demonstrate the effectiveness of the developed tool to determine odor characteristics from sources surrounding the USM Engineering Campus. It is hoped a cost effective and reliable odor assessment tool would improve odor management in Malaysia.

METHODOLOGY

Site of study

Universiti Sains Malaysia Engineering Campus in Nibong Tebal was chosen as the site of study due to some unwanted odour that can be smelt from the campus. The study area extends to 2 km radius of USM (refer Figure 1) as malodours are likely to be dispersed within this area (Sakawi *et. al*., 2010).

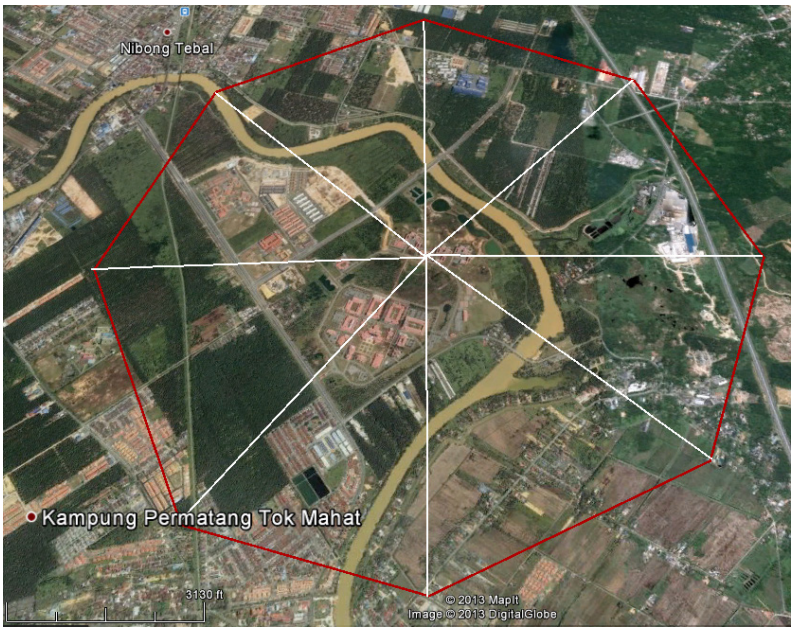

Figure 1: Radius of 2 km plotted from USM (Source: Google Earth)

Ambient source sampling

Odour sampling was done using Ecodrum with a sampling time of about 3 minutes to fill a 15 L sampling bag. The sampling bag is inserted into the Ecodrum as in Figure 2, and in this study, the ambient source was sampled as in Figure 3.

Figure 2: Nalophan bag and the Ecodrum

Figure 3: Ambient source sampling at Poultry processing factory

During the sampling, the Ecodrum funnel is placed at the height of 1.5m from the ground or at the height of the human nose. Samples were taken in the morning and evening to get the average of odour index and to differentiate the emissions of the two sessions. Samples were tested within 30 hours as suggested by MS1963:2007 (Department of Standards Malaysia 2007) to ensure their purity and avoid sample diffusion, which may affect results.

The Odour Threshold Test (OTT)

The Odour Threshold test was developed in the School of Civil Engineering, USM and used to analyse the odour concentration in this study. Figure 4 shows the equipment for OTT including (i) 100ml syringe, (ii) the activated carbon, (iii) odour Tedlar bag size of 25 x 25 cm and also compressed gas. A 100 ml glass-lock syringe was used to transfer the odorant from the nalophan bag (sampled odour) to another (the OTT bags). Glass syringe is encouraged compared to plastic to prevent odour from sticking at the syringe wall and to avoid background odour. The compressed gas for odorant dilution is first run through activated carbon with 0.5 – 1.0 mm size weighing 250g and having density of 0.45g/cm^3 to filter any trace odour, particulates and moisture.

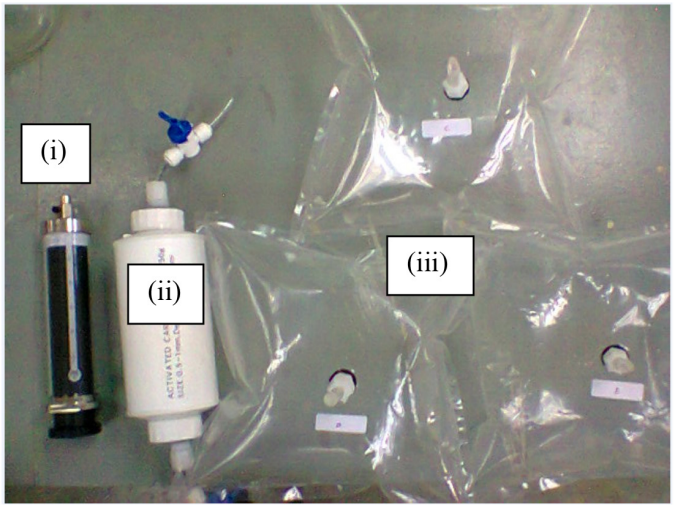

Figure 4: Experimental preparation during the Odour Threshold Test

Odor concentration determination

Approximately 300 ml of the odour sample was injected into one of the three bags, and panelists were asked to identify the odour containing bag. Their responses were recorded into a 'panel response sheet' with a score of 1.00 given for correct guess, 0.33 if unsure and 0.00 for incorrect guess. The sensory test stopped when the average correct answer rate falls below 0.58, instead were repeated with further dilutions for average correct answer above 0.58. The odor concentration was reported as OU/m^3 using Equation 1:

Odour concentration, Z = antilog (Y/10)
Odour index, Y =

where:
M: first dilution ratio
R1: average correct answer rate obtained from the first operation
R0: average correct answer rate obtained from the second operation

Panelist selection

Since the OTT as with other olfactometry methods, rely on human panels as assessors, a panel screening test was first carried out to select suitable panelists for the test. The assessor or panelist

was selected based on their ability to correctly guess five differently smelling chemicals as shown in Table 1. Five paper strips (14 cm x 7 cm) as shown in Figure 5, had three soaked with distilled water, and the remaining strips applied with one of the chemicals. This procedure was repeated for the other four chemicals and the ones correctly identified the two smelling strips each times were selected as the panel.

Table 1: Chemicals used during selection for panel screening

Chemical	Concentration (10^6) ppm	Odour characteristic
2-propanol	0.14	alcohol
Acetic acid	0.11	sour vinegar
Chloroform	0.20	pleasant sweet
Ethyl Acetate	0.12	fragrant
Pyridine	0.016	nauseating

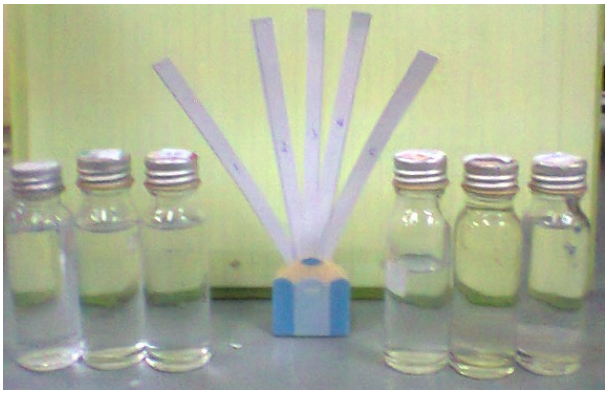

Figure 5: Set up for panel selection with 5 alternative chemicals and distilled water

RESULT AND DISCUSSION

The sources of odour for USM Engineering Campus

The investigation of odour sources within 2 km radius of USM revealed several odour emitting sites as highlighted in Figure 1. The closest odour source, about 1.2 km northeast, is a Palm Oil Mill Factory (POMF) (labeled as # 4 in Figure 6). There are also a Pulp and Paper Mill Factory (labeled as # 5) and a Poultry Processing Factory (labeled as # 3) in the northeast area, about 1.5 km of USM. Two animal husbandries, a cow farm (labeled as #1) and chicken farm (labeled as #2) are found 1.57 km and 1.5 km northwest of USM, respectively. The southern part of USM is mostly residential area and a few schools; hence no odour producing activities were identified. The area where USM currently occupies was historically an oil palm plantation, before 320 acres of land was cleared to make way for the USM Engineering Campus in 2001. As a result, rapid growth in the immediate area surrounding USM was seen thereafter (NHERI 2010), justifying the closeness of the five odour sources to the USM Engineering Campus. The odour nuisance reported by the USM community could be a direct consequence of the encroaching effect between rural and urbanization, especially if the mechanisms to cushion the environmental impact is not yet in place.

Figure 6: Identified sources that might contribute to odour around USM (Source: Google Earth)

The odour characteristics from the various sources

Table 2 shows the odour concentration and description of the smell from the five odour emitting sources identified in Section 3.1. The highest odour emission was from the palm oil mill factory with an odour concentration of 631 OU/m^3, especially in the morning. This helps explain the 'vomit' like smell that is usually evident by the USM Engineering Campus community, especially the student hostels. The closeness of the palm oil mill factory (1.2 km) to USM may have been one of the contributors to the odour complaints at USM, but further validation depicting wind flow is underway to support this early finding.

Table 2: Odour characteristics from the five sources measured in the morning and evening (time)

No.	Site	Odour Concentration		
		A.M (OU/m^3)	P.M (OU/m^3)	Odour Descriptor*
1.	Cow Farm	10.0	5.0	Putrid
2.	Chicken Farm	4.0	10.0	Putrid
3.	Poultry Processing Factory	4.0	25.1	Putrid
4.	Palm Oil Mill Factory	631	20.0	Vomit
5.	Paper Mill Factory	12.6	15.8	Cleaning fluid

*The odour description was based on odour wheel (McGinley *et al,* 2000)

It seems the cow and chicken farm as well as the paper mill factory although are smelly, are likely to cause a nuisance within their compounds given their low odour concentrations of 4 – 15.8 OU/m^3 (McGinley and McGinley 2006). The poultry processing factory having an odour concentration of 25 OU/m^3 has the tendency to disperse a putrid smell beyond the boundary of their facility, depending on the activity that was carried out. For this instance, the slaughtering of

chickens in the evening has likely enhanced malodour that was sometimes smelt in the evening at USM. Again, further analysis involving dispersion theory is needed to verify this.

Sampling error

From the preliminary observation and comparison, it has the demonstrated the capability of the Odour Threshold Test to determine odour concentration locally. It was made apparent that factors such as on-site activities, weather condition and sampling technique could influence the measured odor concentration. Therefore, sampling be best done at ambient temperature, and selection of appropriate sampling apparatus and sufficient attention to sampling condition are advised to minimize error.

If sampling at high humidity (> 90%) and temperature (> 50°C) is unavoidable, pre-dilution is recommended by (Jiang and Kaye, 2001). The pre-dilution procedure and the effect of condensation on results are subjects for further study.

The nalophan bag used for sample collection in this study is recommended as satisfactory storage material (CEN, 1999) and sample loss during storage is also minimal (Jiang and Kaye, 2001). Samples should be analysed as soon as possible because prolonged storage time may caused reduction in sample quality and quantity (Schuetzle *et al.,* 1975). The sampling bag should be rinsed thoroughly with odourless air if it is to be reused, although bag re-use is not promoted.

CONCLUSION

The Odour Threshold Test is practical as it is cost effective in maintenance and involves easy lab procedures. However, the method may require more time and effort in preparation due to its manual nature. There is also a tendency for errors related to sample introduction and dilution using syringes. For future study, it would be recommended to have comparison result between this method and olfactometer to further validate its reliability and promoting its use as an odour assessment tool.

ACKNOWLEDGEMENT

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Nastaein Qamaruz Zaman*, Ros Nadiah Rosli & Nurashikin Yaacof
School of Civil Engineering, Universiti Sains Malaysia,
14300 Nibong Tebal, Pulau Pinang

**Corresponding author*
email: cenastaein@eng.usm.my. Tel: 04 - 5996287

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Comparison of Seismic Design for Ductility Class Low and Medium with Similar Behaviour Factor

Mohd Irwan Adiyanto & Taksiah A. Majid

ABSTRACT

For decades, there is no seismic consideration in Malaysian construction industry since the nation is not located in active seismic fault zones. However, after experiencing tremors from Sumatra Andaman and Philippines earthquakes, local authority start to consider about implementing seismic design for new buildings. According to Eurocode 8, there is three class of ductility namely as low, medium, and high. Now, the question arises among engineers is what class of ductility to be used for Malaysian seismic hazard and its effect on amount of material. From this study, it is found that even have similar size of section and subjected to similar loading, frame designed with ductility class medium require higher amount of steel reinforcement compared to ductility class low. As an example, for column design, ductility class medium require around 50% and 40% higher amount of steel for flexural and shear reinforcement, respectively.

Keywords: Behaviour factor, Eurocode 8, reinforced concrete, ductility, seismic design.

ABSTRAK

Untuk beberapa dekad, tiada pertimbangan seismik diambil kira di dalam industri pembinaan di Malaysia memandangkan negara itu tidak terletak dalam zone aktif seismik. Bagaimanapun, selepas merasai pengalaman gegaran berpunca dari gempa bumi di Sumatera dan Filipina, pihak berkuasa tempatan mula mempertimbangkan untuk mengimplementasikan rekabentuk seismik bagi bangunan-bangunan baru. Menurut Eurocode 8, terdapat tiga kelas kemuluran iaitu rendah, sederhana, dan tinggi. Kini, pertanyaan yang timbul di kalangan para jurutera ialah apakah kelas kemuluran yang akan digunakan bagi ancaman seismic di Malaysia dan kesannya terhadap penggunaan bahan binaan. Daripada kajian ini, adalah didapati bahawa walaupun mempunyai saiz elemen yang sama dan dikenakan bebanan yang sama, kerangka yang direkabentuk dengan kemuluran kelas sederhana memerlukan jumlah besi pengukuhan yang lebih banyak berbanding kemuluran kelas rendah. Sebagai contoh, bagi rekabentuk tiang, kemuluran kelas sederhana memerlukan masing-masing 50% dan 40% jumlah besi yang lebih tinggi untuk pengukuhan lenturan dan ricihan.

Kata Carian: Faktor kelakuan, Eurocode 8, konkrit bertetulang, kemuluran, rekabentuk seismik.

INTRODUCTION

Generally, Malaysian citizen are fortunate because their country is situated relatively far away from active seismic fault zone. For this reason, low rise reinforced concrete (RC) buildings in Malaysia had been designed by consideration of gravitational load (dead and live load) only. For this purpose, structural engineers currently refer to BS 8110 (1997) as standard for RC design. There is no seismic provision included in the standard. However, the west, east, and south part of the nation is surrounded by high seismicity regions. This hazard is created by subduction zones between the Eurasian and Philippines plate at the east part. At the west and south part, the high seismic region associated with subduction zones between Indo-Australian and the Eurasian plate (Pappin et. al, 2011).

Over the past decades, seismic activities in those regions had been rapidly increased. Tremors induced by seismic activities from Sumatra Andaman and Philippines earthquake had been felt in Malaysian soil. A large earthquake on 2004 Boxing Day with magnitude M_w 9.0 which induced disastrous tsunami, followed by 2005 Nias and 2012 Aceh earthquake had became a wakeup call for Malaysian to aware for this new hazard. In medium – to – high risk earthquake zones, the Malaysian Public Work Department (JKR) had suggested that it was worthwhile to consider seismic design for new buildings (MOSTI, 2009).

When earthquake load has to be considered in design, engineers have to deal with the concept of behaviour factor, q. According to Eurocode 8 (2004), the behaviour factor, q is a factor which used for design purposes to reduce the forces obtained from a linear analysis, in order to account for the nonlinear response of a structure. In American code such as IBC (2006), the concept of behaviour factor, q is known as force or strength reduction factor, R. This concept had been proposed in seismic design for economical reason because it is not economically feasible to design structures which can respond elastically during earthquake (FEMA 451B, 2007). According to Eurocode 8 (2004), the material, type of structures, and class of ductility strongly influence the level of behaviour factor, q in design. As an example, the level of behaviour factor, q for regular RC building is equal to 1.5 and 3.9 for ductility class low and medium, respectively.

Main objective of this paper is to study the difference of steel reinforcement and concrete required when different level of ductility is considered in RC design. A regular two storey RC building for office had been designed for ductility class low (DCL) and ductility class medium (DCM) based on Eurocode 2 (2004) and Eurocode 8 (2004). The building is assumed to be located in Sabah, which is a region with highest seismic hazard in Malaysia.

ANALYSIS PROCEDURE.

A 2 dimensional (2D) moment resisting frame of two storey RC building regular in plan and elevation had been used in this study. The frame with three equal bays with 5.0 m length and typical storey height equal to 3.6 m is shown in Figure 1. The same frame had been used by Adiyanto and Majid (2013) in previous work. In this study, the frame had been designed for DCL and DCM by referring to Eurocode 2 (2004) and Eurocode 8 (2004). For comparison, behaviour factor, q equal to 1.5 had been used for both class of ductility. The building is assumed to be

located in East part of Sabah, like Tawau, Lahad Datu, and Semporna which is the region with highest seismic hazard. Therefore, the reference peak ground acceleration, agR for development of response spectrum is equal to 0.12g as proposed by Adnan et. al, (2008) and MOSTI (2009). Both frames had been designed based on yield strength of steel, f_y = 460 N/mm^2 and concrete compressive strength, f_{cu} = 30 N/mm^2..

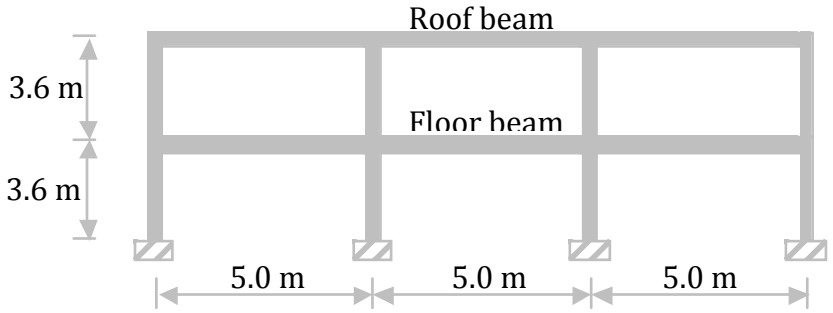

Figure 1 : Elevation of regular RC frame model

In this study, the lateral force method had been performed on both frames. In this method, the earthquake load is represented by lateral load acting on exterior beam-column joint at each storey. For this purpose, the base shear force, F_b had been determined by using equation 1 below as proposed in Eurocode 8 (2004).

$$F_b = S_d(T_1) \,.\, m \,.\, \lambda \tag{1}$$

where $S_d(T_1)$, m, and λ correspond to the ordinate of the design spectrum at period T_1, the total mass of the building above the foundation or above the top of a rigid basement, and the correction factor, respectively. Then, the base shear force, F_b had been proportionally distributed on each storey based on its storey masses, m_i and corresponding storey displacement, s_i at mode 1 of modal analysis. The storey masses, mi had been determined as combination of dead load, G_k and live load, Q_k of each storey as proposed by Rozman and Fajfar (2009). Structural analysis to obtain the bending moment, shear force, and axial load had been conducted based on following load combination as proposed by Eurocode 1 (2002) and Eurocode 8 (2004):

i) Combination 1 = $1.0G_k + \psi_2 Q_k + 1.0E$
ii) Combination 2 = $1.0G_k + \psi_2 Q_k - 1.0E$
iii) Combination 3 = $1.35G_k + 1.50Q_k$

where E represents the Earthquake load. Such combination also had been implemented in previous study by Hatzigeorgiou & Liolios (2010).

In this study, the ordinate of the design spectrum at fundamental period of vibration, $Sd(T_1)$ is determined from response spectrum Type 1 as shown in Figure 2. According to Balendra and Li (2008), buildings built on soft soil are occasionally subjected to tremors although Malaysia is situated on a stable part of the Eurasian plate. Therefore, the response spectrum had been developed to be compatible with Soil D as proposed in Eurocode 8 (2004).

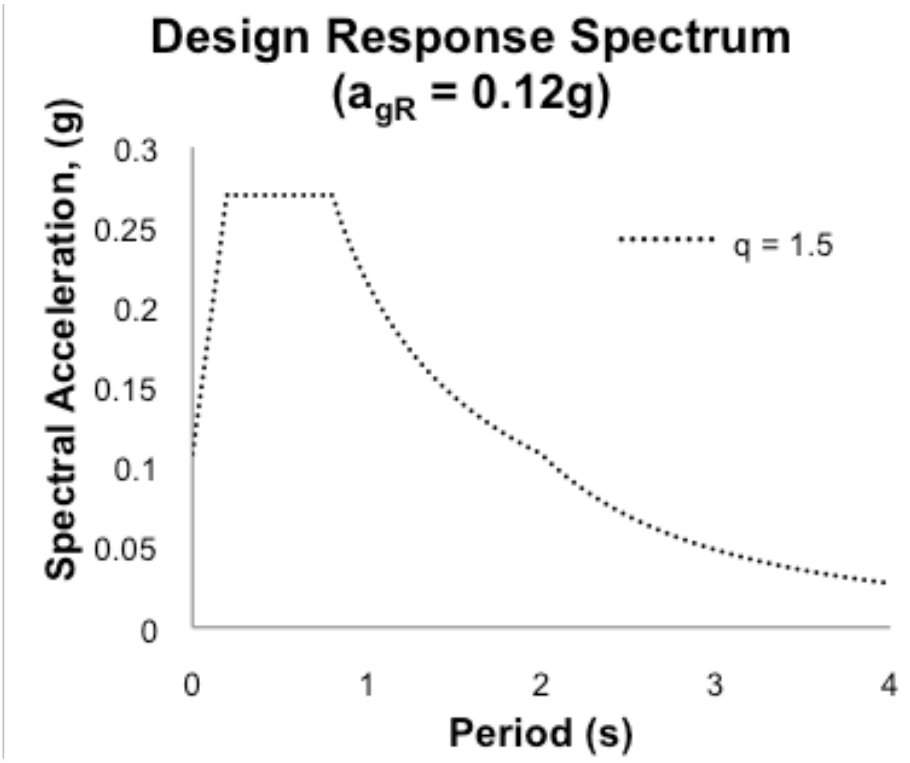

Figure 2 : Design response spectrum for type 1, soil class D, a_{gR} = 0.12g

RESULTS AND DISCUSSION

Comparison of concrete volume

In reality, it is hard to establish the additional cost of providing seismic resistance since buildings tend to be unique projects with different layout and requirement (Booth and Key, 2006). However, it is worth to conduct a study on seismic design and costing so the authority can plan and decide for future development. It is also important in order to give better understanding to structural engineers on which factor influence their design and cost. RC design, either beam or column elements is quite unique because the engineers have to play around with amount of concrete and steel reinforcement (Adiyanto and Majid, 2013). As an example, smaller size of section requires higher amount of steel reinforcement and vice versa. Since using the same level of behaviour factor, q the base shear force, F_b for both DCL and DCM frames is similar and equal to 436.2 kN. Therefore, the lateral load acting on level 1 and level 2 is equal to 189.1 kN and 247.1 kN, respectively. Comparison of total concrete volume used for each element for both DCL and DCM frames is presented in Figure 3. It is clearly observed that the volume of concrete is similar between DCL and DCM frames. This result is applicable for all elements where the size of roof beam, floor beam, and column for both class of ductility is equal to 250 mm x 550 mm, 300 mm x 600mm, and 450 mm x 450 mm, respectively. Therefore, the fundamental period of vibration, T_1 for both frames is similar which is equal to 0.15 second. This result indicates that even designed for different level of ductility, the cost for concrete is similar for two storey office building with seismic consideration in Sabah.

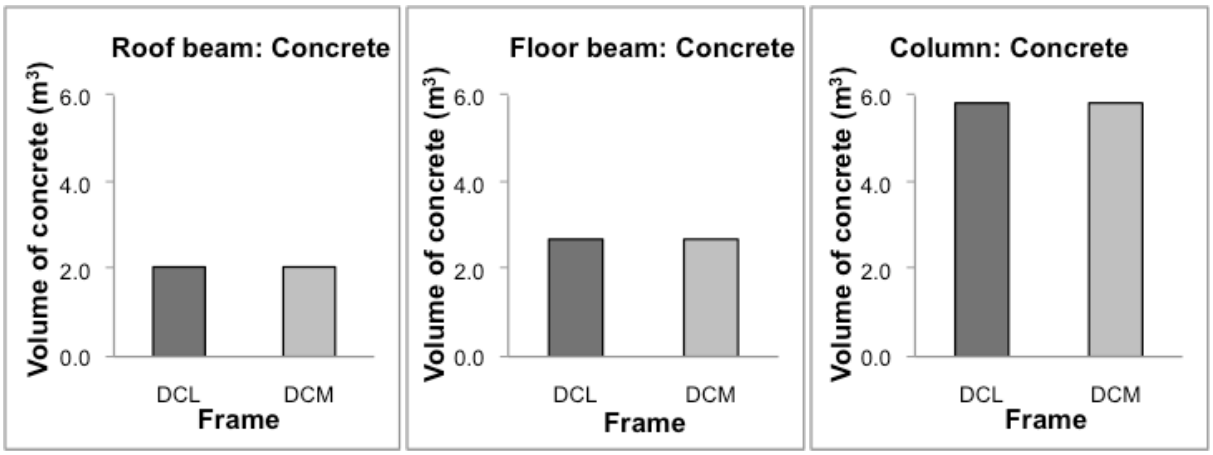

Figure 3: Comparison of concrete volume between DCL and DCM

Comparison of flexural reinforcement

As mentioned in previous section, RC design involves the art of adjusting the size of section and amount of steel reinforcement. So, in order to fulfil the flexural demand resulting from bending moment, the size of section, as well as the size of steel bar and its number has to be selected smartly with limitation of minimum and maximum area of total reinforcement as permitted by codes. Figure 4 depicts the comparison of total weight of steel reinforcement supplied as flexural reinforcement (main bar) for both DCL and DCM frames.

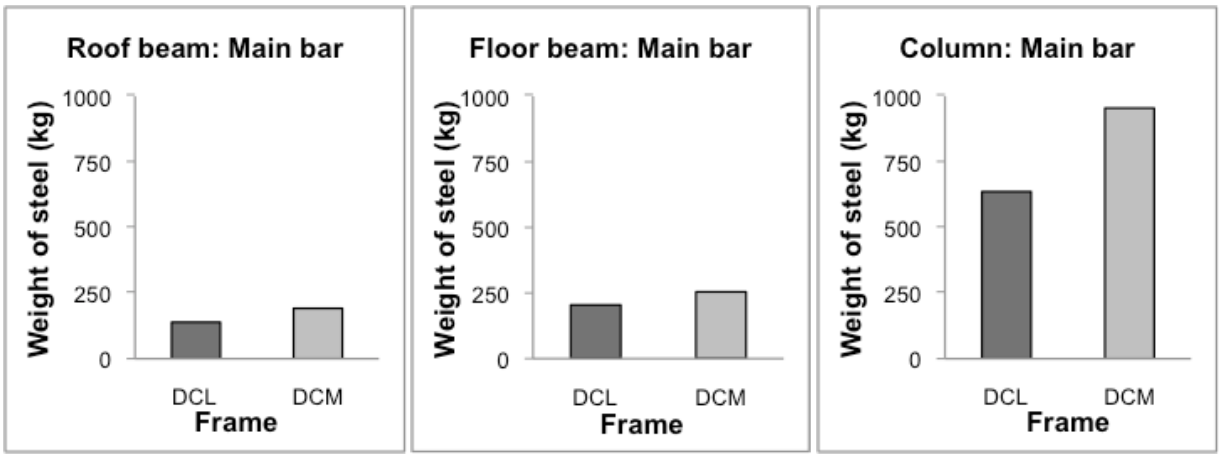

Figure 4: Comparison of weight of main bar between DCL and DCM

From Figure 4, it is clearly observed that the amount of steel reinforcement supplied for DCM frame is higher compared to DCL frame. This result involves all elements including roof beam, floor beam, and column. Logically, the similar lateral and gravitational load assigned on the similar frame resulting on the similar magnitude of bending moment. Therefore, the amount of steel reinforcement to resist the flexural demand should be similar between both DCL and DCM frames. However, due to different class of ductility, this logical assumption never happens.

According to Eurocode 8 (2004), the DCM structures have to fulfil the requirement of local ductility demand. This demand is strongly associated with the limitation of reinforcement ratio in tension zone, ρ. To increase this limitation, the reinforcement ratio in compression zone, ρ' has to be increased by increasing the number of steel bar in compression zone. Therefore, the amount of steel as flexural reinforcement in beam design of DCM frame is higher compared to DCL.

In column design, it can be clearly observed that the total amount of steel reinforcement for DCM frame if around 50% higher compared to DCL frame. For DCL frame, the design of column element is based on its bending moment resulted from analysis (Eurocode 2, 2004). However, for DCM frame the design of column is strongly influenced by its corresponding beam design (Elghazouli, 2009). The magnitude of moment to be resisted by column, M_{Rc} in DCM frame is derived from the design moment of resistance of the beam, M_{Rb}. In seismic design, this concept is known as *Strong Column ~ Weak Beam* philosophy where the capacity of column must be greater than the beam (Elnashai and Sarno, 2009). This is important to prevent the formation of soft storey mechanism (Eurocode 8, 2004). Therefore, when the total amount of steel reinforcement in beam design for DCM frame is high, the moment of resistance of the beam, M_{Rb} also becomes high. Then, the magnitude of moment to be resisted by column, M_{Rc} too is high. Hence, total amount of steel reinforcement in column for DCM frame is extremely higher compared to DCL frame even subjected to the same magnitude of loading.

Comparison of shear reinforcement

If the flexural reinforcement or main bar is designed to resist bending moment, the shear or transverse reinforcement is useful to resist shear force. Shear reinforcement also known as link. Figure 5 presents the comparison of total weight of steel reinforcement supplied as shear reinforcement (link) for both DCL and DCM frames.

In Figure 5, it is clearly presented that total amount of link for roof and floor beam is higher in DCM frame compared to the DCL one. Although have the similar size of beam sections and subjected to the similar loading resulting in similar shear force, the DCM frame requires higher amount of link. This result is strongly associated with different requirement of shear resistance for different class of ductility. For DCL structures, maximum spacing of link, s only depends on effective depth of cross section, d and the inclination of the shear reinforcement to the longitudinal axis of the beam, α (Eurocode 2, 2004). According to Eurocode 8 (2004), for DCM structures, the size of link shall be not less than 6 mm. For such class of ductility, the spacing of link, s depends on the diameter of link, d_{bw}, minimum longitudinal bar diameter, d_{bL} and the depth of beam, h_w. Therefore, the spacing of link, s for DCM structures is smaller compared to the DCL structures resulting in higher amount of shear reinforcement.

The same result also had been obtained for column element. Although have similar cross section, the amount of shear reinforcement in DCM frame is higher than the DCL frame. Like the case of beam element, this result also influences by the requirement of detailing for different class of ductility. According to Eurocode 2 (2004), for DCL structures, the maximum spacing of links, s for column is the least of the following three distances: 20 times diameter of main bar,

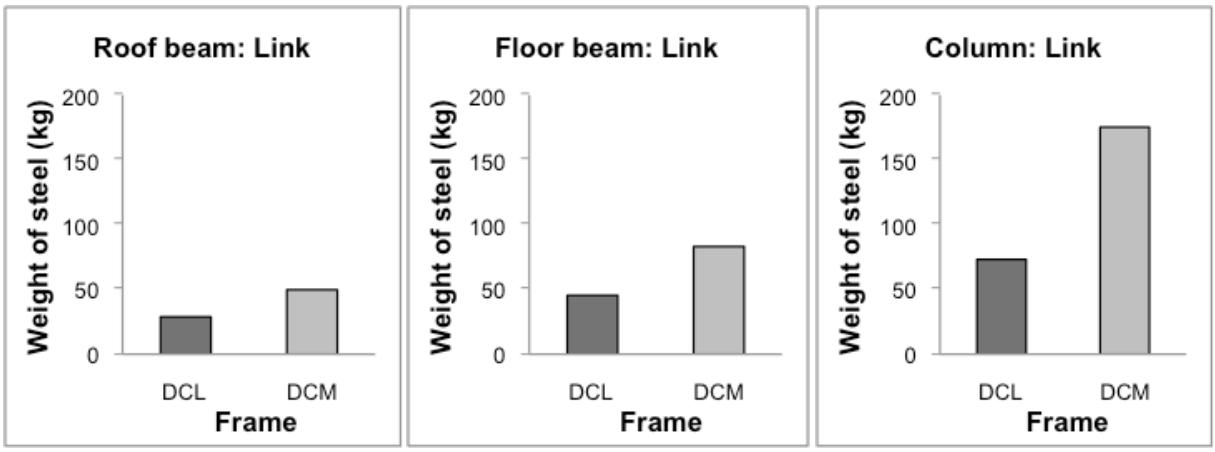

Figure 5: Comparison of weight of link between DCL and DCM

the lesser dimension of column, or maximum limit at 400 mm. For DCM structures, special attention has to be given for shear reinforcement in column (Eurocode 8, 2004). This is known as the requirement of confinement reinforcement which is strongly depends on curvature ductility factor, μ_ϕ normalised design axial force, ν_d design value of tension steel strain at yield, $\varepsilon_{sy,d}$ gross cross-sectional width, b_c and width of confined core,b_0. The mechanical volumetric ratio of confining hoops within the critical regions, ω_{wd} shall be sufficiently provided in order to fulfil the requirement of confinement reinforcement. The best way to cater for this requirement is by decreasing the spacing of link, s, which will increase the provided mechanical volumetric ratio of confining hoops within the critical regions, ω_{wd} as explained by Elghazouli (2009). Therefore, in this study total amount of shear reinforcement in column for DCM frame is around 1.4 times higher than the DCL frame.

CONCLUSION.

In this study, two typical frames of double storey RC building for general office use had been designed with seismic consideration based on two different class of ductility: low and medium. This is important to study which class of ductility is suitable to be implemented in Malaysia for seismic design. For both frames, the earthquake load had been derived based on lateral force method by using behaviour factor, q equal to 1.5. Based on this study, several conclusions might be drawn as follow:

- In term of concrete volume, there is no difference for both class of ductility where both frames have similar size of section for all elements resulting in similar fundamental period of vibration, T_1.
- Total amount of steel provided as flexural reinforcement for DCM frame is higher compared to the DCL one. For beam element, this result is caused by the requirement of local ductility demand which is to be fulfilled for DCM structures. For column, the *Strong Column ~ Weak Beam* philosophy had been implemented for DCM structures where

the capacity of column must be greater than the beam. Therefore, the amount of steel reinforcement in column for DCM frame is around 50% higher compared to DCL frame.

- The same result also obtained for shear reinforcement associated with special requirement of detailing which had to be provided for DCM structures. Therefore, it can be concluded that the cost of material for DCM is higher compared to DCL even subjected to the similar magnitude of loading.

LIST OF ABBREVIATIONS.

RC	Reinforced concrete
DCL	Ductility class low
DCM	Ductility class medium
2D	2 Dimensional

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Mohd Irwan Adiyanto
Postgraduate Student, Universiti Sains Malaysia, Penang, Malaysia
irwano_07@yahoo.com, 0175316653

Taksiah A. Majid
Disaster Research Nexus, Universiti Sains Malaysia, Penang, Malaysia
taksiah@eng.usm.my

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Fabrication of ZnS:Ni^{2+} Nanocrystals by Reverse Micelle Method

R. Mohd Ibrahim, M. Markom & H. Abdullah

ABSTRACT

In this work we synthesized $Zn_{1-x}Ni_xS$ with x =0.00,0.02,0.04,0.06,0.08 and 0.10 nanoparticles by reverse micelle method using sodium bis(2-ethylhexyl) sulfosuccinate (AOT) as surfactant. The prepared particles were characterized using Fourier transform infrared (FT-IR) and X-ray diffraction (XRD) for particles formations. UV-vis spectrometry, X-ray diffraction (XRD) and transmission electron microscopy (TEM) for optical, size and morphology of the samples . UV-vis absorbance spectra for all of the synthesized nanoparticles show the maximum absorption for all samples is observed at range 210 - 300 nm . The size of particles is found to be 3-5nm range by calculated from Uv-vis and XRD results. Nanoparticles size from TEM shows significant results from UV-vis and XRD Diffraction data. The absorption edge shifted to lower wavelengths when doping with ion Ni as per UV-Vis spectroscopy. The band gap energy values were increase from 4.50eV to 4.90 eV. This blue shift is attributed to the quantum confinement effect.

Keywords: Nanoparticles; UV-vis absorbance spectra; quantum confinement effect.

INTRODUCTION

Research on nanosize semiconductors have grown rapidly over the past decade. This is because the optical properties of novel electronic arising from quantum confinement effect, which vary significantly in size (1). Recombination of electron hole pairs in the semiconductor particles drastically reduced with the reduction of particle size. When semiconductor particle size reduction to the nanometer size scale, the semiconductor band gap energy increased greatly, thereby leading to the high redox potential of the system. In addition, nanoscale semiconductor particles have a higher surface to volume ratio of their peers and thus allowing greater absorption of photons at the surface of the photocatalyst (2,3). Therefore, the nano-scale semiconductors are expected to have higher photocatalytic activity than the bulks.

Among the semiconductor nanoparticles, the synthesis of II-VI semiconductor nanopartical has been extensively studied(4). Zinc sulfide is one of an important II-VI semiconductors which direct band gap semiconductor material that has great value 3.6eV band gap energy. It has wide spectrum of potential applications such as in catalysis, electronics and optoelectronic nanodevice (5,6) . In recent years, considerable interest focuses on the transition metal ion doped ZnS nanosemiconductor to form a new class of luminescence materials by modification of the band structure. Recently, nicel has been found to be a prospective doping materials in ZnS nanoparticles.

In the present study, we synthesized undop ZnS and $Zn_{1-X}Ni_xS$ nanoparticles with x=0.00,0.02,0.04,0.06,0.08 and 0.10 by reverse micelle method using n-haptane, water and AOT as a reaction medium. The size, morphology and structure of the resulting particles were investigate. The obtained nanoparticles were characterized using UV-visible spectroscopy (UV-Vis), x-ray diffraction (XRD) and scanning electron microscopy (SEM).

EXPERIMENT

Synthesis of ZnS:Ni^{2+} nanoparticles were prepared in H_2O/AOT/n-haptane reverse micelle method using precipitation technique. The selected W [(H_2O)/(AOT)] in molar ratio values was 7 in all preparation solution. An aqueous solution of 0.5M zinc acetate $Zn(CH_3COO)_2.2H_2O$, 0.5M sodium sulphide Na_2S and 0.5 M nickel (II) acetate $Ni(CH_3COO)_2.2H_2O$)] were prepare separately. For the synthesis of the doped, different volume was added to different beakers of ZnS with x = 0.00, 0.02, 0.04, 0.06, 0.08 and 0.1 as the molar concentration of Ni^{2+}. Then the solution was stirrer for 30 minutes for completion of ion Ni^{2+} in the aqueous solution of zinc acetate. On the other hand an individual reverse micelle of AOT enclosing $Zn_{1-x}Ni_xS$(x =0.00,0.02,0.04,0.06,0.08,0.10) solution and Na_2S solution were prepared separately. The prepared two solutions were mixed with continuous stirring at 80^0C for 30 minutes. Then, an individual reverse micelles of AOT enclosing Na_2S solution was added drop by drop into the Zn^{2+} and Ni^{2+} mixture with continuous stirring until a homogeneous solution was obtained. The mixture was then allowed to stand for 1 day in the oven in constant temperature of 40^0C for precipitation. After that, the precipitate was repeatedly washed with ultra pure water ethanol. Finally, the precipitate was dried in the oven for one day at 40^0C. The product was obtained as a white powder for undop ZnS and grey powder for Ni^{2+} dop ZnS. The same procedure was followed for all ZnS:Ni ratio. The formation of undop ZnS and ZnS:Ni(x=0.00,0.02,0.04,0.06,0.08,0.10) was studied using Fourier transform infrared (FT-IR) and X-ray diffraction (XRD). The optical absorption spectra of the same particles in ultrapure water were recored using UV-vis spectra and while size and morphology of the particles were determines using transmission electron microscopy (TEM).

Results and Discussion

FT-IR study

FT-IR spectra of the undop ZnS and Ni doped ZnS nanoparticles were recordED in the range of 4000 – 400 cm^{-1} as shown in Figure 1 below. The peak appearing at 1016, 617 and 482 cm^{-1} are due to Zn-S vibration (7). After doped with ion Ni^{2+} at x = 0.02 to 0.10, the peak at 1160 cm^{-1} appear due to Ni-S vibration. These results show that Ni^{2+} atom was partially substituted into Zn position in ZnS nanoparticles. The partial metal substitution results were consistent with XRD experiment. While the broad absorption peak in the range of 3000 – 3600cm^{-1} corresponding to –OH group indicates the existence of water absorbed in the surface of nanoparticles (8). The bands at 1500-1650cm^{-1} are due to the C=O stretching modes arising from the absorption of atmospheric CO_2 on the surface of the nanoparticles. The obtained peak values are in good agreement with the literature (9).

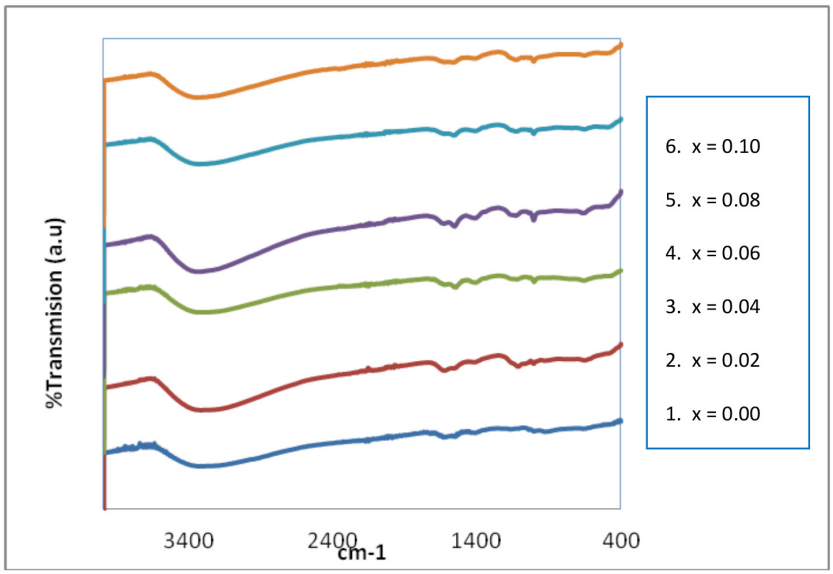

Figure 1: FTIR spectra of $Zn_{1-x}Ni_xS$(x=0.00,0.02,0.04,0.06,0.08,0.10)

X-ray diffraction

XRD pattern for prepared samples are showed in Figure 2 . From this figure, the X-ray powder diffraction of nanoparticles ZnS and ZnS:Ni revealed that both nanoparticles have zinc blende structure with plane at (1 1 1), (2 2 0) and (3 1 1) . The broadening of the XRD pattern of the prepared samples were due to nano crystalline nature of particles. From the XRD results, the average crystallize size is calculated using the Debye Scherer formula (10).

$$D = 0.89\lambda/(\beta\cos\theta) \quad (1)$$

Where λ is the wavelength of incident X-ray (1.54 A) and θ is the Brangg's angle. From the calculation, the average diameter of the particles are 2.46 nm for undop ZnS and 2.51 nm for Ni dop ZnS. The substitution of higher radius Ni^{2+} ions (r_{Ni}^{2+} A) to parts of Zn^{2+} ion (r_{Zn}^{2+} = 0.78 A) in the ZnS structure leads to slightly increase in nano particles size of ZnS. This increase of particles size equivalent with the decreasing in the lattice parameter of ZnS as shown at the most intense peak (1 1 1) plane in Figure 2. This is due to a very small amount of ion doped into ZnS lattice which gives the strong evidence for the incorporation of dopant ion into the host matrix.

Optical absorption and optical band gap

The room temperature UV-vis spectra of undop ZnS and doped ZnS:Ni^{2+} are shown in Figure 3. As seen in the figure , the absorption edge of undop ZnS is observed at the 250nm and 313nm while for all sample for ion Ni^{2+} dop ZnS show absorption edge at 255nm The two absorption edge for undop ZnS are due to the formation of two groups size of the particles. After doping with ion nickel, the absorption value shift to the one absorption edge and become more homogeneous. The shift of absorption edge for doped ZnS was a results from incorporated of ion Ni^{2+} in the crystal structure of ZnS. However, for different percentage of ion doping in ZnS crystal structure does not shows any shifting in absorption value. This result probably was come from the effective small percentage of dopants. However, it shows significant increase in the absorption value that

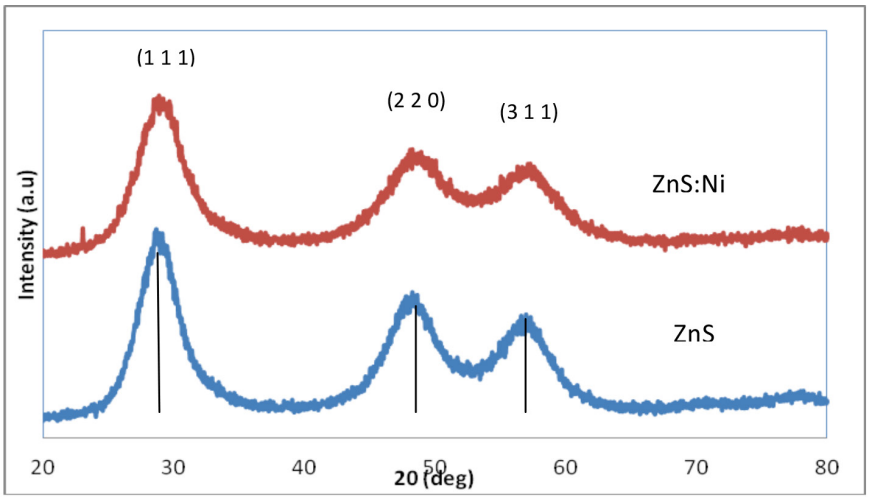

Figure 2: XRD pattern of ZnS and ZnS:Ni(6%) nanoparticles

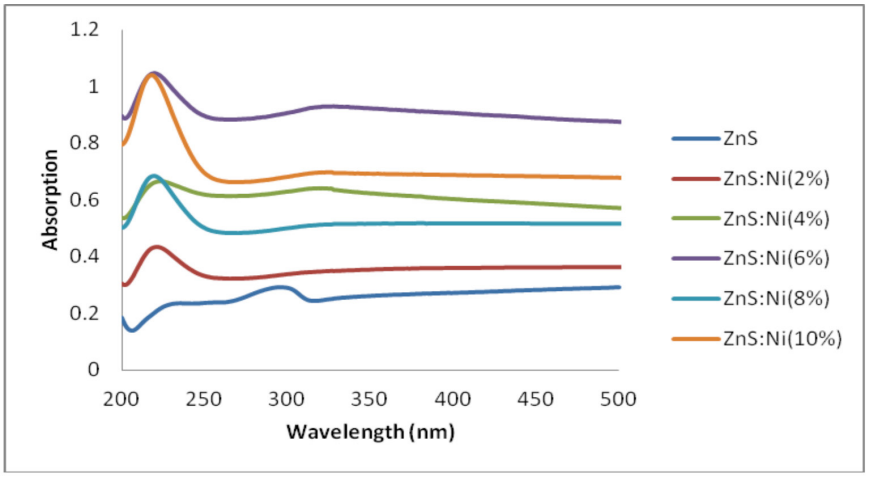

Figure 3: UV-vis absorption spectra of undop ZnS and Ni dop ZnS nanoparticles

indicate wide distribution of nanoparticles at corresponding absorption wavelength area. It also shows a very monodispersed nanoparticle distribution.

The optical absorption spectrum probes the internal molecular orbital which corresponding to electron excitation from the valance band to conduction band . This information can be used to determine the nature value of the optical bandgap . From Figure 4, the absorption coefficients (α) were calculated. The relation between absorption coefficient (α) and incident photon energy (hv) can be written as :

$$\alpha = A(hv - E_g)^n / hv \quad (2)$$

Where A is a constant and E_g is the band gap of the material and the exponent n depends on the type of the transition. For direct and allowed transition n=1/2, indirect transition, n=2 and for direct forbidden, n = 3/2. The band gap was calculated by plotting of $(\alpha hv)^2$ versus Energy(Ev) as shown in figure 4 below. The calculated band gap value are 4.9eV for ZnS and 4.5 eV for

ZnS:Ni(6%). From the band gap value, the particles size was calculated using the mathematical model proposed by Brus(11) as below:

$$E_{gn} = [\ E^2_{gb} + \{2h^2E_{gb}(\pi/R)^2/m^*\}]^{1/2} \quad (3)$$

Where R is the radius of the quantum size particles, E_{gn} and E_{gb} are the band gap of nano and bulk systems, respectively and m^* is the effective electron mass ($m^* = 0.22m_e$). The average particles size are 8.0 nm and 8.7nm for undoped and doped ZnS nanoparticles respectively. The obtained value of both samples are higher than that of bulk value of ZnS(3.72eV). This blue shift of the bandgap takes place because of the quantum confinement effect (12).

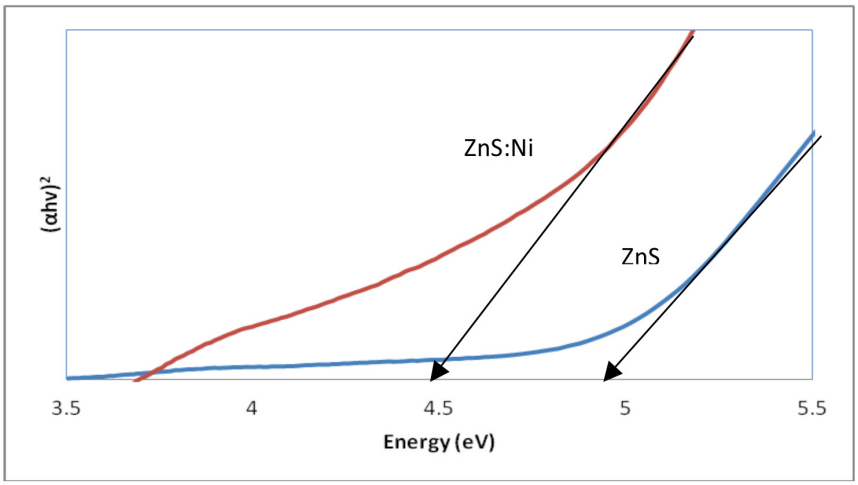

Figure 4: Calculation of optical bandgap from UV-vis absorption spectra.

TEM analyses

Size and morphology of Ni doped ZnS nanoparticles analyzed by TEM is represented in Figure 5. The image reveal that the particles have smooth surface with the size of 3-5nm for undop ZnS and 4-6nm for Ni dop ZnS. The results are slightly larger than the size estimated by the Scherrer formula calculation and Brus formula. The comparison of the results are show in the Table 1.

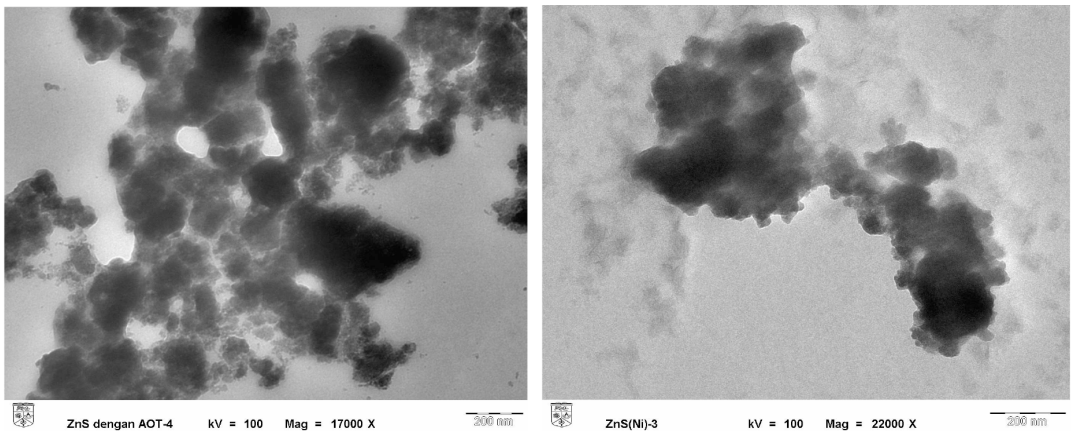

Figure 5: Transmission Electron Microscopy (TEM) image of undop ZnS(a) and Ni \ZnS(b) sample which shows the increase of particles .

Table 1

Sample	Band gap eV	UV-vis (nm)	XRD (nm)	TEM (nm)
ZnS	4.9	3.05	2.46	4.0
ZnS:Ni	4.5	3.40	2.51	5.0

CONCLUSIONS

Ni^{2+} doped ZnS nanoparticles have been successfully synthesis by reverse micelles method using precipitation technique. It has zinc blande structure, as observe by X-ray diffraction and incorporated of ion Nickel as shown in FT-IR results analysis. The average size lies in the range of 2.5 – 4.5nm for the undop and cparticles and band gap values increase greatly from the bulk value. The optical studies show that the absorption peak of the doped ZnS nanoparticles are markedly blue shifted which clearly indicate the strong quantum size effect.

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R. Mohd Ibrahim
Department of Chemical Engineering and Process
Faculty of Engineering and Built Environment
Universiti Kebangsaan Malaysia
43600 UKM Bangi, Selangor, Malaysia.

M. Markom
Department of Chemical Engineering and Process
Faculty of Engineering and Built Environment
Universiti Kebangsaan Malaysia
43600 UKM Bangi, Selangor, Malaysia.

H. Abdullah
Department of Electrical, Electronic and System Engineering
Faculty of Engineering and Built Environment
Universiti Kebangsaan Malaysia,
43600 UKM Bangi Selangor, Malaysia

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Coconut Husk as Carbon Source For Bioethanol Fermentation

Kho Soon-Hang, Hii Siew-Ling & Ong Lisa-Gaik-Ai

ABSTRACT

Bioethanol is regarded as a promising biofuel for fossil fuels substitution due to its environmental benefits. Second generation biofuels are refined from cellulosic wastes and has became key area in bioethanol research due to relative abundance in quantity and low cost of feedstocks. In the present study, powderised coconut husk is the key cellulosic waste to be used as substrate for simultaneous saccharification and fermentation (SSF) of bioethanol in a 2-L stirred tank bioreactor. Batch fermentation parameters including effect of substrate concentration, aeration rate, agitation speed, and aeration control strategy were evaluated in this study. The kinetic parameters of fermentation processes were also investigated. Prior to the SSF process, the powderised coconut husk was pretreated by microwave-assisted-alkaline method.SSF were carried out using *Saccharomyces cerevisiae* (ATCC®36858) at 10% v/v of inoculum size, 37 °C of temperature and pH5.0. From thestudy, bioethanol production was enhanced with increasing initial concentration of coconut husk in the bioreactor. The maximum bioethanol concentration of 1.4 g/L (bioethanol yield of 0.0467g/g) was attained when 30 g/L of powderised coconut husk was used. After final optimisation, the bioethanol production reached 4.14 g/L (bioethanol yield of 0.1380 g/g) by cultivating *Saccharomyces cerevisiae* at low agitation speed (200 rpm) under facultative mode throughout the whole process. Any further decrease or increase in agitation speed did not improve the bioethanol fermentation process.The system was further assessed by using aeration control strategy. In this strategy, the system was supplied with 1 vvm of sterile air into the bioreactor for the first 24 h before switched to facultative phase. However, bioethanol obtained using this strategy was low (2.65 g/L). Nonetheless, the results of this study indicating that coconut husk could be a potential lignocellulosic biomass for bioethanol production towards sustainable energy generation.

Keywords: Bioethanol; coconut husk; *Saccharomyces cerevisiae*; SSF.

INTRODUCTION

Fossil fuels such as oil, coal, natural gas are the main energy sources for world's present economy. However, several negative impacts from fossil fuels including energy crisis, global warming, volatile oil price have urged researchers to look for renewable fuels such as bioethanol and biodiesel, which collectively known as biofuels (Uihlein & Schebek 2009). According to Simmons (2007), 70% of world's oil is used for transportation while this sector remains the fastest growing end-use energy sector. In 2007, there were about 806 million cars and light trucks on the road. This number will continue to rise to approximately 1.3 billion by 2030 and to over 2 billion vehicles by 2050 (Balat 2011). This will cause rapid depletion of fossil fuels in near future. In addition, burning

of fossil fuels results in emission of greenhouse gaseous (GHG) such as carbon dioxide, methane, and nitrous oxide. These GHG has caused climate change, global warming, acid rain and human health deterioration (Soccol et al. 2010). Thus, attention has shifted to the use of renewable fuels such as bioethanol as an alternative energy source for liquid fuel (Zhang et al. 2011).

Biofuels are generally derived from plant, which is able to offset the carbon dioxide emissions from combustion of fuels to support growth (Mabee, 2006). The main advantage of using biofuels is they can be blended in gasoline to power transportation sector (Tan et al. 2008b). Biofuel production using energy crops, including cassava, sweet potato, corn, wheat and sugarcane, is referred to as first generation biofuels. Energy crops have been extensively used as feedstock for bioethanol production in the present due to high sugar content and high bioethanol yield. Despite the advantages of using energy crops for bioethanol production, they also pose several disadvantages. Agricultural crops such as corns, wheat, sugarcane and palm oil, are extensively consumed as food and food products such as cooking oil and sugar. Due to limited agricultural land, high cost of feedstock which competes for food consumption, the used of first-generation biofuels impose high cost to consumers (Tan et al. 2008b).

Alternatively, the research has recently focuses on production of bioethanol from lignocellosic materials, which referred to as second generation biofuels. Lignocellulosic materials including agricultural residues, forestry residues, food processing wastes and other cellulosic materials are cheap sources for bioethanol production (Sarkar et al. 2012). Lignocellulosic materials mainly comprise of cellulose, hemicelluloses and lignin. These long chain polysaccharides must first hydrolyzed to pentoses and hexoses before fermentation of bioethanol is possible. Thus, these feedstocks are first subjected to different pretreatments to release the sugars from cellulose and hemicelluloses. The types of pretreatment implemented include physical, chemical andbiological pretreatments (Sun & Cheng 2002). The hydrolysis and saccharification of cellulose to glucose follows the reaction below.

$$n C_6H_{10}O_5 + H_2O \rightarrow n C_6H_{12}O_6$$

During fermentation process, glucose is fermented through following reaction (Wyman & Hinman 1990).

$$C_6H_{12}O_6 \rightarrow 2\ CO_2 + C_2H_5OH$$

Hence, the choice of feedstock is crucial, where amount of cellulose present directly proportional to glucose produced.

Coconut husk is an agriculture waste which comprise of coir and coir dust. It takes up the largest portion of a coconut fruit by dry weight. A dry coconut fruit compose of 44% husks, 33% copra and 23% shell, while a coconut husk contains 28% cellulose, 38% hemicelluloses and 32.8% lignin (Raghavan 2010). It was reported that 114, 730 hectares of land was used for coconut plantation in Malaysia in 2008 (Ministry of Agriculture 2009)and it was estimated that 5,280 kg of dry husks were become available per hectare per year. In Malaysia, coconut husks were used as fuel for coconut processing, as a domestic fuel and as a source of fibre for rope and mats (Tan et al. 2008a). In India, the utilisation of coconut husks was only around 30%. The

dry husks were used as kindling material, filling material for seats, mattresses and brushes. The remaining dry husks were used for moisture conservation in agriculture and destroyed as waste materials (Lim et al. 2000). To make better use of this cheap and abundant agriculture waste, present study aimed to pretreat and hydrolyse coconut husk into reducing sugars which can be used as potential carbon source for fermentation process.

The present work aims to assess the potential of using Malaysian agricultural waste (coconut husk) as carbon source for bioethanol production. Batch fermentation strategies such as effects of concentration of substrate loading, aeration rate, agitation speed, and aeration control strategy were assessed in a 2-L stirred tank reactor. The kinetic parameters (yield, productivity, specific and volumetric rate) of fermentation processes were also determined.

MATERIALS AND METHODS

Microorganism and materials

Baker's yeast, *Saccharomyces cerevisiae*(ATCC®36858) was grown in standard yeast extract, peptone and dextrose (YPD) medium (yeast extract 10 g/L, peptone 20 g/L, dextrose 20 g/L) before used as inoculum for bioethanol production in 2-L stirred tank reactor.

Collection, processing and pretreatment of coconut husks

Coconut husks were collected from coconut farm at Setiawan, Perak, Malaysia. The dry husks were then grinded and sieved to particle size ranging from 850 - 1400 μm before subjected to microwave-assisted-alkaline pretreatment using 3% (w/v) sodium hydroxide (0.75 M).

Batch bioethanol fermentation using 2-L stirred tank reactor

Simultaneous saccharification and fermentation (SSF) experiments were carried out in a 2-L stirred tank reactor at 1.5-L working volume. Fermentation medium consists of yeast extract and peptone (yeast extract 10 g/L, peptone 20 g/L) as nutrients and pretreated coconut husks as carbon source. Inoculum size of 10% v/v, temperature of 37°C and pH 5.0 were used throughout the study. Sample volume of 10 mL was taken from the bioreactor every 12 h for analysis.

Effect of different concentrations of coconut husk

Different concentrations of pretreated coconut husk (5 g/L, 10g/L, 15g/L, 20g/L and 30g/L) were used as carbon source for batch fermentation of bioethanol. The agitation speed and aeration rates were fixed constant at 200 rpm and 0.5 vvm, respectively.

Effect of aeration and agitation rates

The effect of three aeration rates (0 vvm, 0.5 vvm and 1.0 vvm) on bioethanol fermentation was investigated. After the best aeration rate was determined, the effect of agitation speed (100 rpm, 200 rpm, 300 rpm, 400 rpm and 500 rpm) was investigated. Optimised concentration of pretreated coconut husk(30 g/L) from earlier study was used for the rest of the investigation, otherwise specify.

Aeration control strategy

Batch fermentation system was further assessed with aeration control strategy to increase biomass growth in the first 24 h by supplying 1.0 vvm of sterile air to the system. The air supply was terminated thereafter and the facultative mode of fermentation commenced to stimulate bioethanol formation. This aims to increase the number of cell in the system initially to stimulate production of ethanol afterwards during facultative phase.

Analysis

Cell growth was measured directly from sample taken using CFU (colony forming unit) method through serial dilutions and spread plate. Reducing sugars and bioethanol concentration were determined by harvesting the supernatant of sample taken after centrifugation at 6000 rpm for 5 mins. Reducing sugars were analysed using DNS (3,5-dinitrosalicylic acid) assay and absorbance were read at 540 nm using spectrophotometer. Bioethanol concentration was analysed with GC (gas chromatography) using FID (flame ionisation detector). GC analysis conditions were (1) injector: 140 °C temperature, (2) WAX-PLUS column: 35 °C of column temperature, (2) detector: 280 °C temperature.

RESULTS AND DISCUSSION

Figure 1 shows the maximum cell growth and bioethanol production in batch mode with different initial concentrations of pretreated coconut husk. By increasing the coconut husk concentration from 5 to 30 g/L, the maximum concentration of bioethanol increased from 0.0224 to 1.4 g/L.With the presence of higher coconut husk concentration in the medium, higher amount of reducing sugars could be obtained. Thus, the cell growth was enhanced with increasing amount of reducing sugars as carbon source and greater amount of bioethanol was produced. Based on the result, pretreated coconut husk at concentration of 30 g/L was selected for subsequent fermentation process. Too high concentration of insoluble coconut husk particles in the fermentation broth resulted in high viscosity of the system which also mimics the condition of semi-solid state fermentation. High concentration of WIS (water insoluble solids) lower bioethanol yield by increasing mass transfer resistant and inhibitors level in the fermentation broth (Hoyer et al. 2009). Hence, the effect of coconut husk concentration higher than 30 g/L was not investigated in this study.

Based on Table 1, the highest amount of bioethanol (4.14 g/L) was recorded when the system was operated in facultative mode at low agitation (200 rpm). By increasing the aeration rate from 0 vvm to 1 vvm, cell growth was greatly induced (1.47g/Lto 4.48g/L). This is due to increase in cellular's oxidative metabolism at high aeration rate (Alfenore et al. 2004). However, maximum bioethanol obtained decreased when more air was supplied to the system. The results indicated that high aeration rate favours the growth of *Saccharomyces cerevisiae* whereas anaerobic phase is more suitable for bioethanol fermentation.

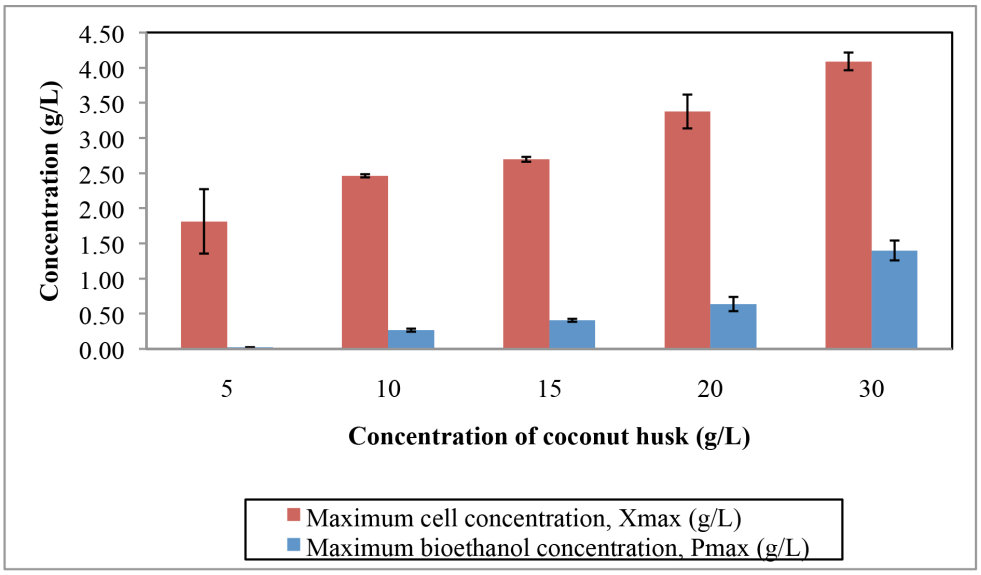

Figure 1: Bioethanol production using different concentrations of coconut husk as carbon source. Data are mean ± standard deviation of two independent experiments. For data point without error bars, the errors were smaller than the size of symbols.

Low agitation speed was not efficient in enhancing the production of bioethanol (Table 2). By using agitation speed of 100 rpm, low level of bioethanol (3.27 g/L) was recorded. Proper homogeneity was not achieved at low agitation speed which reduced the biomass growth and thus resulted in lower bioethanol production (Szymanowska & Grajek 2009). Likewise, when agitation speed greater than 200 rpm was applied to the system, bioethanol production reduced significantly although higher biomass could be achieved. As observed from Table 2, the maximum bioethanol level dropped from 4.14 g/L at 200 rpm to 3.40 g/L at 500 rpm. Contrary, biomass growth increased from 1.47 g/L at 200 rpm to 1.94 g/L at 500 rpm. By increasing the agitation speed, mass transfer was improved in the system and thus provides better contact of substrates, products or by products, and dissolved oxygen between cells and fermentation broth (Rodmui et al. 2008). Results of current study indicated that higher agitation directs the yeast to grow rather than focuses on bioethanol production. Facultative fermentation at agitation speed of 200 rpm was the most suitable condition for batch bioethanol production in stirred tank reactor with the highest bioethanol yield recorded (0.1380 g/g).

Table 1: Effect of aeration rate on bioethanol production by *Saccharomyces cerevisiae* in 2-L stirred tank bioreactor.

Kinetic parameter	Aeration rate (vvm)		
	0	**0.5**	**1.0**
Maximum ethanol production, P_{max} (g/L)	4.14	1.40	0.26
Ethanol productivity, P (g/L/h)	0.0288	0.0583	0.0217
Ethanol yield, $Y_{P/S}$(g ethanol/g substrate)	0.1380	0.0467	0.0085
Maximum cell concentration, X_{max} (g/L)	1.47	4.09	4.48
μ_{max} (h^{-1})	0.065	0.108	0.108

Figure 2 compares the bioethanol production between facultative and aeration control cultivation processes. During aeration control process, sterile air at 1 vvm was supplied into the bioreactor for the first 24 h with the purpose to stimulate yeast's growth and the air supply was switched off thereafter. From the study, bioethanol production is higher during facultative batch process (4.14 g/L) as compared with aeration control process (2.65 g/L), with the ethanol productivity of 0.0288 g/L/h and 0.0197 g/L/h, respectively. Although the maximum growth rate of yeast was identical for both processes (0.065 h^{-1}), higher cell concentration was achieved in the aeration control process (1.85 g/L compared to 1.47 g/L). Reducing sugar from coconut husk was believed to be consumed mainly for maintaining higher cell growth and hence resulted in lower bioethanol yield during aeration control process.

Table 2: Effect of agitation speed on bioethanol production by *Saccharomyces cerevisiae* in 2-L stirred tank bioreactor.

Kinetic parameter	Agitation speed (rpm)				
	100	200	300	400	500
Maximum ethanol production, P_{max} (g/L)	3.27	4.14	3.85	3.23	3.40
Ethanol productivity, P (g/L/h)	0.0210	0.0288	0.0267	0.0245	0.0236
Ethanol yield, $Y_{P/S}$(g ethanol/g substrate)	0.1090	0.1380	0.1283	0.1077	0.1133
Maximum cell concentration, X_{max} (g/L)	0.58	1.47	1.51	1.55	1.94
μ_{max} (h^{-1})	0.014	0.065	0.070	0.062	0.032

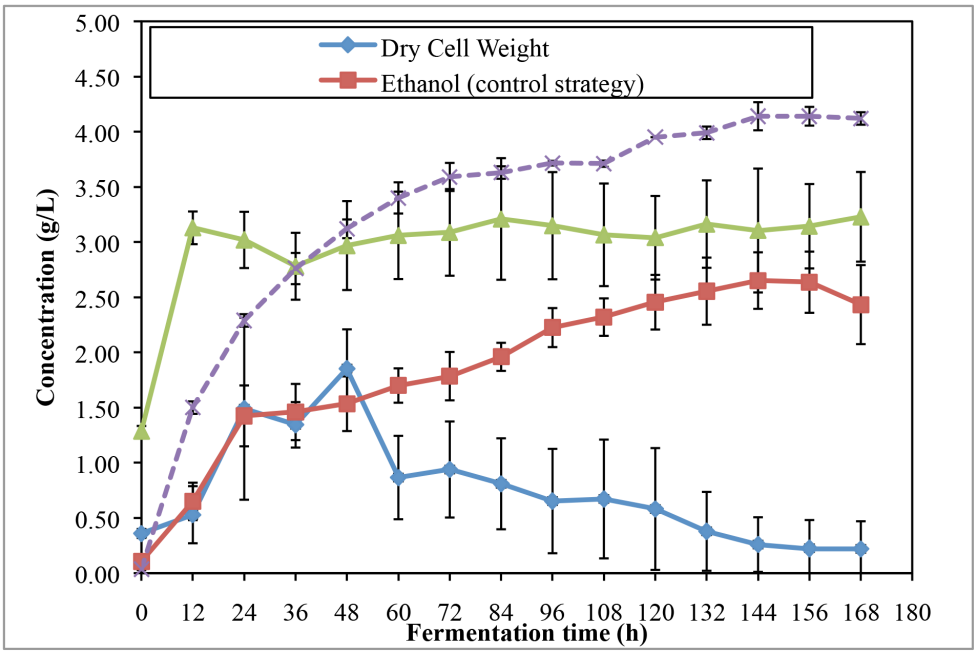

Figure 2: Bioethanol production based on aeration control strategy in batch fermentation of *Saccharomyces cerevisiae*. Symbols: (♦), dry cell weight; (▲), reducing sugars; (■), bioethanol concentration; (x), bioethanol concentration for conventional anaerobic batch process. Data are mean ± standard deviation of two independent experiments. For data point without error bars, the errors were smaller than the size of symbols.

CONCLUSION

In conclusion, higher bioethanol production was achieved by increasing amount of pretreated coconut husk as carbon source in the bioreactor. As high as 1.4 g/L of bioethanol was obtained when 30 g/L of coconut husk was used as carbon source. By further optimization of the fermentation conditions, significantly higher level of bioethanol (4.14 g/L) could be achieved under facultative fermentation condition (without supply of air) at 200 rpm of agitation speed in comparison with other fermentation conditions. Bioethanol fermentation efficiency decreasedwhen higher amount of air (0.5 and 1.0 vvm) or agitation (300, 400 and 500 rpm) were supplied to the system. No improvement in bioethanol production with aeration control strategy although higher cell concentration was obtained. Hence, facultative fermentation process is a promising mode of cultivation for bioethanol production using bioreactor.

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Kho, Soon-Hang
Department of Chemical Engineering
Faculty of Engineering and Science
UniversitiTunku Abdul Rahman
53300 Kuala Lumpur, Malaysia

Hii, Siew-Ling*
Department of Chemical Engineering
Faculty of Engineering and Science
UniversitiTunku Abdul Rahman
53300 Kuala Lumpur, Malaysia
**Corresponding author. Tel.: +60 16 252 9002*
E-mail address: hiisl@utar.edu.my

Ong, Lisa-Gaik-Ai
Department of Biological Science
Faculty of Science
UniversitiTunku Abdul Rahman
31900 Kampar, Perak, Malaysia

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i-PQF: The Dynamic Software Quality Model Using Feature Ranking Technique (FRTMPF)

Jamaiah H. Yahaya, Siti Sakira Kamaruddin,
Aziz Deraman & Ruzita Ahmad

ABSTRACT

This article presents a dynamic and intelligent software quality model using feature ranking technique for the purpose of dynamically selecting the appropriate attributes for software quality assessment. The existing software quality models only support static set of attributes and do not include the dynamic and intelligent attributes selection process. The model also known as i-PQF has a capability to learn from previous experiences. The basic model of software quality is adopted from earlier model which is known as PQF model. In this research, the proposed feature ranking technique (FRT) adopts both the filter and wrapper approach to learn and rank quality attributes as new software quality assessment data are added to the database. A ranking model named Most Priority of Features (MPF) is introduced to perform the ranking. The issue of redundancy during ranking is addressed using classifiers that are able to learn the most suitable attributes from existing data. Evaluation of the proposed technique is performed through comparison with similar technique in the area and the results shows that our technique performs better in terms of correlation to human judgment. The proposed software quality model (i-PQF) is beneficial to be used and applied in software engineering for software assessment as benchmark quality criteria.

Keywords: Software quality model, feature ranking technique, intelligent software quality model, i-PQF, Most Priority of Features (MPF)

INTRODUCTION

Software quality and assessment have been seen as the important topics and discussions in software engineering to ensure the software being developed meets certain level of standard accepted by the industry as well as by the stakeholders, users or customers. Several software quality models have been developed since the years of 1970s till today to fulfill the need for software assessment benchmark and criteria. At the same time, many complaints have been reported regarding quality of the software. These reports claimed that software quality is deteriorated steadily and worsening. Users reported and claimed that software was delivered with bugs that need to be fixed and dissatisfied with the product (Whittaker & Voas, 2002; Denning, 1992).

Similar situations were being observed in Malaysia where a study was conducted in 2006 showed that almost 50% of the surveyed respondents agreed that quality of the software was rated not good and only 50% agreed and indicated that the software operating in their environments were good (Yahaya, Deraman & Hamdan 2006). This result was consistent with the results of

other studies on software quality by Voas (2000), Punter et al (2004) and Javed et al. (2012). Many related works have been carried out in software quality domain but not much focused on the extended from the current software quality models and approaches.

Software quality can be assessed through three categories of assessments: internal measures, external measures and quality in use measures (ISO/IEC 9126). Internal measuring is the evaluation based on internal attributes typically static measures of intermediate products and external measuring is based on external attributes typically measuring the behavior of the code when executed. While the quality in use measures includes the basic set of quality in use characteristic that affect the software. This characteristic includes effectiveness, productivity, safety and satisfaction. Among these measures, there are several measures that are subjective and unquantifiable to be measured objectively especially software measures that are related to human aspects.

Previous software quality models (Dromey, 1998; Suryn et al., 2002; Suryn, Abran & April, 2003; Yahaya, Deraman & Hamdan, 2008a) measure the software quality based on technical aspects and theories. A more comprehensive measurement was developed by Yahaya, Deraman & Hamdan (2008a) and known as Pragmatic Quality Factor (PQF) model. This model consists of all the technical aspects of the software with the addition of the human aspects. PQF is a practical software quality model that has been tested in several case studies, involving several large organisations in Malaysia (Yahaya, Deraman & Hamdan, 2008b; 2010). However, this model operates on a set of static quality attributes and measures. Similar to all other previous software quality models, PQF model is not flexible and incapable to capture current and future requirements. The capability is needed because as we observe from previous study indicated that quality attributes may change based on current demand, requirements and environment.

In this work, we propose a dynamic software quality model using a filter-wrapper based feature ranking technique to enable the model to learn and rank software quality attributes based on previous software quality assessment dataset. We propose a filter based approach by introducing a ranking model named Most Priority of Feature (MPF) and in resolving the issue of redundancy and subjectivity of measurement, we propose a wrapper approach where we focus on a learning process using classifiers on attribute scores given by quality assessors. Quality scores are relatively very subjective and difficult to be determined distinctively therefore, the proposed model is designed to identify and recommend to the environment the relevant attributes that are given high scores based on previous cases of software quality assessment data. The rest of the paper is organized as follows: in the next sections, the background studies in software quality will be discussed and follows by related works in artificial intelligence (AI). Then we move on to the discussion on achieving intelligence in software quality model and the last section concludes this paper.

SOFTWARE QUALITY MODELS

International Organization for Standardization (or ISO) defines software as "all or part of the programs, procedures, rules, and associated documentation of information processing system". Software product is defined as "the set of computer programs, procedures, and possibly associated documentation and data designated for delivery to a user" (ISO/IEC, 9126). Quality is defined as

"the totality of features and characteristics of a product or services that bear on its ability to satisfy stated or implied needs" (Jenner, 1995). Software quality monitoring and assessment is defined as the establishment and operation of appropriate model, methods, systems and procedures necessary to monitor, compile, and analyze data regarding the condition of software being used in the organization.

Several well-known models have been developed to measure software product in term of its quality. Such models are McCall (1976), Boehm (1978), FURPS (1987), ISO9126 (1991), Dromey (1996) and etc. Most of these models focused on measuring software based on developer's views and perspectives. Some of these models were well-known models that been used as the benchmark for related quality researchers but they seemed unsatisfactory for giving assurance to the users and stakeholder in term of quality of the assessed software at any particular time and phase of its lifecycle. In similar situation, measuring software based on the development process has come out with several models such as CMMI, SPICE, BOOTSTRAP and etc. These models were designed for software process improvement in the organisations and not focused on individual software product assessment and evaluation. Recently ISO/IEC 29119 has introduced Software Testing Model that can be used as an international standard for software testing and this model is still in construction phase and at a release working draft (ISO, 2011). In this model, the testing approach will be applied in a testing laboratory.

Our research group has developed a new software quality model called PQF model which enhanced from ISO 9126 model. It has several capabilities such as the attributes are based on technical as well as human perspective. This model has a capability to accommodate the organisation's business requirements where each attribute has the associated weight to represent the relevancy of the attribute to the organization impact (refer to Yahaya & Deraman, 2010). The features are summarized and shown in Table 1. Table 2 compares PQF model with other software quality model. It shows all the possible software quality characteristics and maps into each software quality models available in the literature.

Table 1: Features and capabilities of the PQF model (Yahaya & Deraman, 2010)

	Exhibit capability
1.	Provides an alternative means to certify software product in a collaborative perspective approach among users, developers and independent assessors. It is considered to provide confidentiality, security and privacy of the software. This approach accelerates the process and eliminates bias during assessment.
2.	Provides means to identify quality status of a product using PQF in a practical environment. The quality attributes embedded in PQF is more convincing that meets the additional aspect of quality. The additional aspect of quality deals with human aspects and does not cover in previous software quality models.
3.	Provides means to offer flexibility in obtaining certification level with a guided procedure of initializing weight values on quality attributes to meet an organisation's business requirements.

Table 2: Quality characteristics present in PQF and previous models (Yahaya & Deraman 2010)

Quality characteristics	McCall (1976)	Boehm (1978)	FURPS (1987)	ISO 9126 (1991)	Dromey (1996)	Systemic (2003)	PQF (2007)
Testability	x	x					
Correctness	x						
Efficiency	x	x	x	x	x	x	x
Understandability		x			x		
Reliability	x	x	x	x	x	x	x
Flexibility	x						
Functionality			x	x	x	x	x
Human engineering		x					
Integrity	x						x
Interoperability	x						
Process Maturity					x		
Maintainability	x	x	x	x	x	x	x
Changeability		x					
Portability	x	x		x	x	x	x
Reusability	x				x		
Usability			x	x		x	x
Performance	x		x				
User Conformity							x

Nowadays, many software companies are shifting from traditional software development phases and cycle to a shorter development and release cycles (Khomh et al. 2012). How do we guarantee that the shorter development and release cycle do not affect the quality of the software products? The impact of this adoption on software product quality has not been established yet. Thus, the study in software quality model must underline with the current approach in software development as well.

ARTIFICIAL INTELLIGENCE

There are several studies conducted in software engineering particularly in software quality that have included artificial intelligence techniques for several purposes. Some of the identified studies are summarised next.

Khoshgoftaar, Szabo and Guasti (1995) studied on exploring the behaviour of neural network in software quality models. Data is collected from components in large commercial software systems and trained them using neural network to observe the relationship between software complexity metrics and software quality metrics.

Lees, Hamza and Irgens (1996) investigated the using and applying of case based reasoning (CBR) and quality function deployment (QFD) in software quality assessment. Their aim was to develop a CBR oriented software quality advisor to support the attainment of quality in software development. This was done by reference to quality case histories using software modules from previous designs.

The third study was conducted by Goa, Khoshgoftaar and Wang (2009) which dealt with an empirical investigation of filter attribute selection technique for software quality classification. The artificial intelligence technique chosen was feature selection. Feature selection is a process of selecting a subset of relevant features for building learning models. This technique is relevant and appropriate for data preprocessing used in software quality modelling and other data mining problems. This study investigated the performance metrics using multilayer perceptron (MLP) learner with nine different performance metrics.

Colin J. Burgess (2000) investigated research in software quality management using artificial intelligence. This research studied the used of artificial intelligence techniques to solve problems in software quality management. It outlined four areas where artificial intelligence techniques have been successfully used. The areas are: 1. The application of genetic algorithms and other search techniques to aid the automatic generation of structural test data. 2. The application of genetic algorithms to the testing of real-time systems. 3. The use of influence diagrams to aid the management of software changes. 4. Improving the cost estimation of software projects.

Another research in the areas of software quality and AI was conducted by Martín Agüero et al. (2010). This research presented a software quality support tool which was a Java source code evaluator and a code profiler based on computational intelligence techniques. It proposed a new approach to evaluate and identify inaccurate source code usage and transitively the software product itself. The aim of this research was to the software development industry with a new tool to increase software quality.

A review on current techniques in artificial intelligence has come up with three suggested techniques or methods for handling dynamic quality model proposed in this research. The techniques being identified are feature selection (FS), artificial neural network (ANN) and case-based reasoning (CBR). This paper only discusses the feature selection technique.

Feature Selection

Feature Selection (FS) is a process of selecting a subset of relevant features for building learning models and it used to remove less important features from the training data set. Feature Selection as an important activity in data preprocessing used in software quality modeling and data mining problems that has been extensively studied for many years in data mining and machine learning.

Feature selection technique is divided into two categories which are feature ranking technique and feature subset selection technique. Feature ranking technique assesses attributes individually and ranks the attributes according to their individual predictive power. Whilst, feature subset selection technique selects the subset of attributes that collectively have good predictive capability. In feature subset selection technique contains two difference approaches to subset selection which are filter approach and wrapper approach. By using the filter approach, the feature subset is selected independently of the learning method which means ignoring the induction algorithm to assess the merits of features from data. Whilst, wrapper approach is selected using the same

learning algorithm that will used for learning on domain represented with the selected feature subset. In this approach, the feature subset selection is done by using the induction algorithm as a black box which means no knowledge of the algorithm is needed. The feature subset selection algorithm conducts a search for a good subset using the induction algorithm itself as a part of the evaluation function (Tadeuchi et al., 2007; Blum & Langley, 1997; Guyon & Elisseeff, 2003; Forman, 2003).

Feature selection (FS) is a process of selecting relevant features for building learning model and it used to remove less important features from the data set (Guyon, 2003). The aim of FS is to improve the classification performance and to offer and improved realization of the fundamental process that created the data. FS has been applied to software quality assessment model to identify the most promising quality attributes that is able to increase the efficiency of software classification (Gao, Khoshgoftaar & Wang, 2009; Khosgoftaar et al., 2003; Wang et al., 2010).

Goa, Khoshgoftaar and Wang (2009) studied on empirical investigation of filter based feature ranking techniques (FRT) for software quality classification was performed. Here, a number of filter based feature ranking techniques were used to predict the quality of software modules as either fault prone or not fault prone. They showed that the performance of the filter based feature ranking techniques varies depending on the classifiers and the performance metrics used to measure the efficiency of the classification results. Gao, Khoshgoftaar and Wang (2009) applied Filter Attribute Selection (FAS) to perform attribute selection before classification. FAS is a process of selecting a subset of relevant features for building learning models. The idea behind this technique is to remove less important features from the training data set. They tested four FAS techniques and concluded that the technique proposed by Khosgoftaar et al. (2003) i.e.; the Kolmogorov-Smirnov Correlation Based Filter (KSCBF) performed better for the software quality problem. Therefore in this work we compare our proposed technique to KSCBF.

In our work a feature ranking technique is proposed which combines the filter and the wrapper approach. The proposed technique scores each software quality attributes according to a proposed scoring method called Most Priority of Feature (MPF). In the case where there are more than one attribute with same MPF score, the attribute is trained and tested for classification. In our case, the MPF scoring is considered as the filter approach and, we consider the learning process as the wrapper approach where we investigate how well the attribute perform in the classification task. As a contrast to previous work in software quality feature selection methods, our proposed method focuses on learning the weights that is assigned by assessors that indicates the relevancy of a particular software quality attributes.

ACHIEVING INTELLIGENCE IN SOFTWARE QUALITY MODEL

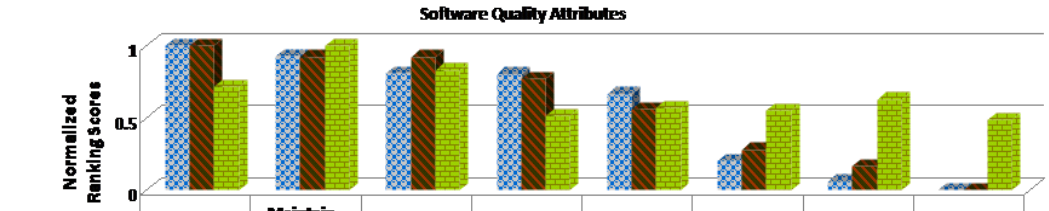
This section describes our proposed Feature Ranking Technique (FRT). As mentioned earlier our proposed FRT applies both the filter and wrapper approach. We propose a two phase ranking technique. The filter approach is implemented in Phase 1 where the Most Priority of Feature (MPF) method is used to calculate for all attributes and then checked and ranked. If there is more than one highest MPF score, Phase II will be executed where the wrapper approach is implemented. The proposed FRT is called FRTMPF for easier referencing. Shows the proposed FRTMPF.

Table 3 presents the algorithm to accomplish this task in more detail. The explanation and discussion of this algorithm can be found in Kamaruddin et al. (2012).

Table 3: Algorithm of i-PQF using FRTMPF

Steps	Algorithm
1	Get the software quality attributes and quality scores from the PQF database
2	Use the quality score value to calculate the MPF scores for all attributes
3	Sort and rank the attributes according to the highest MPF scores.
4	If there are more than one highest MPF score For each of the attribute with same MPF score Begin a. Get the corresponding data and quality score from the PQF database b. Input the data into two classifiers c. Calculate the average classification accuracy of the two classifiers d. Output the average classification accuracy End
5	Select the attribute with the highest classification accuracy
6	Output the ranked software quality attributes

The evaluation of the FRTMPF algorithm and i-PQF were carried out using experimental approach. The experiment is to evaluate the effectiveness of the proposed FRTMPF and i-PQF model. The experiment was conducted using a dataset which was taken from previous cases in quality and certification data (Yahaya et al., 2008b; Yahaya et al., 2010). The scores computed by FRTMPF associates better to expert ranking compared to other method such as KSCBF. The correlation coefficient shows that FRTMPF strongly correlates with the expert judgment. The reasons for high performance of FRTMPF are the calculation of MPF scores and the resolution of the redundancy issues in the attribute ranking. The combination of the filter and wrapper approach in FRTMPF algorithm has proved to be very promising. Figure 1 shows the graph for ranking result of FRTMPF, KSCBF and expert. More experiment results and report can be referred in Kamaruddin et al. (2012).



	User Factor	Maintain-ability	Usability	Functionality	Portability	Reliability	Efficiency	Integrity
Domain Expert	1	0.92366	0.80916	0.80153	0.66412	0.2061	0.06107	0
i-PQF	1	0.92077	0.92077	0.7726	0.56103	0.28085	0.16556	0
KSCBF	0.717	1	0.829	0.513	0.569	0.549	0.629	0.483

Figure 1: Ranking Results

CONCLUSION

Software quality is a research area that fall in the nich of cyberspace security in the National Strategic ICT Roadmap. In this roadmap indicates that the cyberspace encompases not only the uses of Internet but also less visible systems and infrastructures. The growing dependence of these brings about the critical need to protect from destruction and incapacitation. Previous research has identified factors and attributes for static quality model. Several quality models have been developed with limited capabilities especially in term of dynamic and flexible quality attributes. Previous experience in software assessment discovered that the attributes or characteristic associated with software quality might change based on environment and time. Therefore, this research aims to construct a dynamic software quality model for effective software assessment that hopefully can guarantee the development of quality software in the organisations in this industry.

The baseline model used in this research consists of two main attributes: the behavioural and the human aspect. It is named as PQF model. The behavioural attributes deals with assessing software product to ensure the quality of the software and how it behaves in certain operating environment. They are also known as quality in use. While the impact attributes deal with how the software reacts and impacts to the environment. These two components of quality produce a balance model between technical requirement and human factor (Yahaya, Deraman & Hamdan, 2008a). The available software quality model such as the ISO 9126 model does not accommodate the other aspects of software quality requirements (ISO/IEC 9126).

The proposed dynamic model (i-PQF) has a capable to identify and recommend to the environment if there is any new attributes to be included in the model. Thus the model will be updated and fulfilled with current and future requirements of assessment. This is done using artificial intelligence, which is the feature ranking technique as discussed in this paper. The research was conducted in five main phases which include: 1) the theoretical study; 2) design of formal framework on intelligent software quality and assessment; 3) model the software quality using artificial intelligence technique; 4) construction of intelligent model of software quality and assessment and; 5) confirmation study. The i-PQF model provides the FRTMPF algorithm that support the dynamic software quality model criteria. I-PQF can be used and applied for assessing software product using intelligence technique, which is useful for organization in selection and assessment of software as well as to integrate in future researches as a quality benchmark.

The proposed i-PQF with FRTMPF technique are benficial to the software engineering and software industry which can be used as a dynamic and intelligent software quality model. It is an enhanced and improved model because of the dynamic attributes allowing the model to adapt itself to a particular environment or may recommend to the environment for new relevant attributes. This will also to ensure that the quality of the software meets the nation's and organisation's requirements and standards in current and future.

FUNDING SOURCES

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Jamaiah H. Yahaya*
corresponding author Centre for Software Technology and Management
Faculty of Information Science and Technology
Universiti Kebangsaan Malaysia, Bangi, Malaysia.
jhy@ftsm.ukm.my, Tel: 6019-2206702

Siti Sakira Kamaruddin
Ruzita Ahmad
School of Computing, UUM College of Arts and Sciences,
Universiti Utara Malaysia, Kedah, Malaysia.
sakira@uum.edu.my, rita_azura@yahoo.com

Aziz Deraman
Department of Computer Science, Faculty of Science and Technology
Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia
a.d@umt.edu.my

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Tsunami Vulnerability Assessment Mapping for the West Coast of Peninsula Malaysia using Geographical Information System (GIS) Technique

Najihah Remali, Mohd Effendi Daud & Hairunnisa Md Arus

ABSTRACT

The catastrophic Indian Ocean tsunami of 26 December 2004 raised a number of questions for scientist and politicians on how to deal with the tsunami risk and assessment in coastal regions. This paper discusses the challenges in tsunami vulnerability assessment and presents the result of tsunami disaster mapping and vulnerability assessment study for West Coast of Peninsula Malaysia. The spatial analysis was carried out using Geographical Information System (GIS) technology to demarcate spatially the tsunami affected village's boundary and suitable disaster management program can be quickly and easily developed. In combination with other thematic maps such as road maps, rail maps, school maps, and topposheets it was possible to plan the accessibility and shelter to the affected people. The tsunami vulnerability map was used to identify the vulnerability of villages/village population to tsunami. In the tsunami vulnerability map, the intensity of tsunami was classified as hazard zones based on the inundation level in meter (contour). The approach to produced tsunami vulnerability assessment map consists of considering scenarios of plausible extreme, tsunami-generating events, computing the tsunami inundation levels caused by different events and scenarios and estimating the possible range of casualties for computed inundation levels. The study provides an interactive means to identify the tsunami affected areas after the disaster and mapping the tsunami vulnerable village before for planning purpose were the essential exercises for managing future disasters.

KEYWORDS: Geographical Information System (GIS), Risk Assessment

INTRODUCTION

The earthquake has triggered giant tsunami and the tsunami waves that propagated throughout the Indian Ocean caused extreme inundation and extensive damage, loss of property and life along the coasts of 12 surrounding countries in the Indian Ocean. The loss of lives also extended to the people from a total of 27 countries from other parts of the world. The number of casualties and missing person from the countries bordering Indian Ocean (AFP, 2005) is given in Table 1. The tsunami waves arrived at the North of Sumatra coastline in half an hour. The waves reached the coasts of Thailand, Sri Lanka, India and Maldives within hours and also arrived at Somalia in Africa, some hours later. The number of casualties and missing people are listed in Table 1 (AFP, 2005) and Figure 1 shows the recent earthquakes along the subduction zones had generated tsunami events (USGS). The total number of death toll in the list shows that this tsunami is the most destructive ever experienced in human history. Because of its exceptional character,

it is clearly seen that, the magnitude of North Sumatra Earthquake has not only triggered a tsunami and cause damages and loss of lives but also shaken the psychology, social life, scientific considerations, understanding of hazards and priorities of mitigation measures in the region. This event will remain as the most important item in the agenda of assessment of natural hazards in the long run (Yalciner, 2005).

Table 1: The number of casualties and missing from the Countries Bordering Indian Ocean (AFP, 2005), (The official number of casualty in Malaysia is 69 including one missing)

Country	Dead	Missing
Indonesia	125,598	94,574
Thailand	5,395	3,001
Sri Lanka	30,957	5,637
India	10,749	5,640
Myanmar	61	
Maldives	82	26
Malaysia	68	1
Somalia:	298	-
Tanzania	10	-
Bangladesh	2	-
Kenya	1	-
TOTAL	173,221	108,879

Understanding the dynamics of the Indian Ocean Tsunami will provide us with very valuable experience, knowledge and sense to develop a better defense against natural hazards.

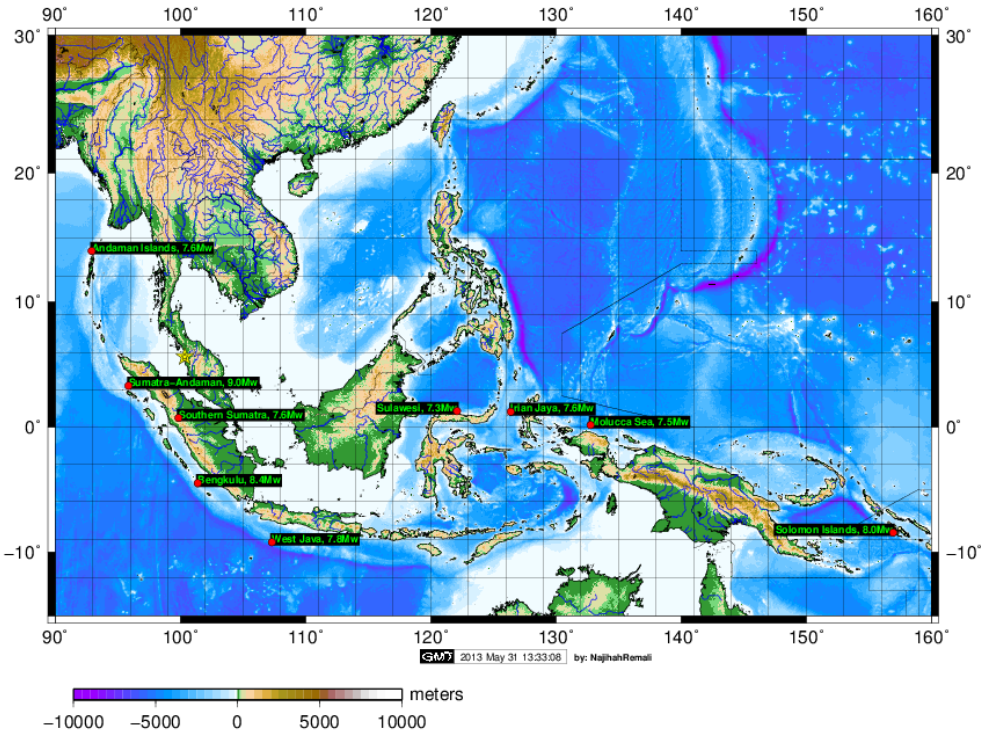

Figure 1: Epicenters of the recent earthquakes that generated the tsunami event.

TSUNAMI GENERATION AND PROPAGATION

Tsunamis are generated by submarine earthquakes, volcanic eruptions or landslides. Such submarine geological process produces water surface disturbance, or the tsunami source, which propagates toward the coasts. "Tsunami" is a Japanese term, meaning "harbor wave". A tsunami is usually small in deep ocean, but becomes larger and more dangerous toward shallow water and causes coastal damage. Tsunami propagation in deep ocean is rather simple; the velocity depends only on water depth. Once the initial condition, or the tsunami source, is known, the propagation and coastal behavior can be modeled by computer simulation. Such an approach is called forward modeling, and used for engineering and hazard assessment purposes Figure 2.

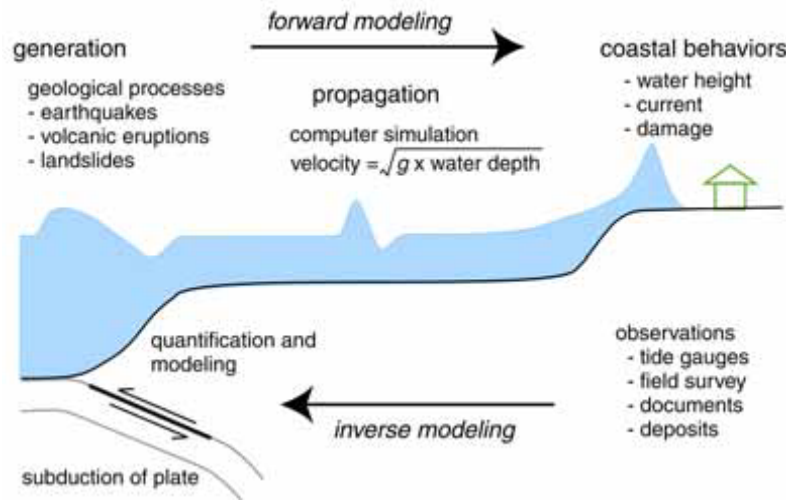

Figure 2: Tsunami Generation and Propagation (Satake and Fuji, 2006)

Tsunami Generation by Earthquakes

The earth's surface is divided into a dozen of tectonic plates which move each other. In the source area of Sumatra-Andaman earthquake, the Indian plate is sinking beneath the Burma microplate at a rate of about 5 cm per year. This subduction causes the upper plate to be dragged and deformed up to a certain limit. When the strain reaches the limit, the two plates are rebound to cause an earthquake. This motion, called faulting, is the mechanism of an interpolate earthquake, and largest earthquakes in the world occur in subduction zones. While the epicenter of the December event was located west of Sumatra Island, the aftershock zone extended through Nicobar to Andaman Islands; the total length of the fault is more than 1,000 km. The fault parameters can be estimated from seismological analysis. The product of fault length, width and slip, as well as rigidity near the fault, is known as seismic moment, and indicates the physical size of the earthquake source. Once the fault parameters are known, seafloor displacement, which becomes the tsunami source, can be computed by using the elastic theory of dislocation. Recent seismological developments, both in theory and observation, make it possible to estimate the earthquake source parameters within minutes after large earthquakes and utilize it for the tsunami warning purposes. In addition, tsunami data, such as waveforms recorded on tide gauges, run-up heights measured by field surveys, damage data described in historical documents and tsunami deposits, are used to study the tsunami sources.

Tsunami Propagation

Tsunamis are considered as a shallow water, or long, waves. Depending on the relation between wavelength and water depth, water waves can be classified as shallow water (or long) wave or deep water (short) wave. The Indian Ocean or Andaman Sea is deep, up to 4,000 m or 4 km, but the wavelength of seafloor deformation is an order of 100 km, much larger than the water depth. Hence we can use the shallow water approximation for tsunamis generated from earthquakes. One of the characteristics of the shallow water is that the wave velocity is given as a square root of g times d, where g is gravitational acceleration, 9.8 m/s2, and d is water depth in meters. If d is 4,000m, the velocity is about 700 km/h. For shallow water, at 40 m, the velocity is about 70 km/h.

Tsunami Observations

To document the 2004 tsunami, many scientists and engineers from all over the world visited the affected coasts. The measured tsunami heights in Sumatra Island, particularly around Banda Aceh, were mostly larger than 20 m with the maximum of 30 m. The tsunami heights along the Andaman Sea coast were highly variable; 5 to 15 m in Thailand but less than 3 m in Myanmar. The tsunami heights were up to 5 m on India's Andaman Islands. In Sri Lanka, the tsunami heights were 5 to 15 m. The tsunami height distribution is consistent with the damage distribution, and indicates that the source of the large and damaging tsunami was concentrated in the southern 700 km section of the aftershock zone.

In Figure 3, the overall view of tsunami affected areas along the west coast of Peninsular Malaysia is shown. The tsunami affected areas along Kedah and Langkawi coast are also shown in Figures 4.

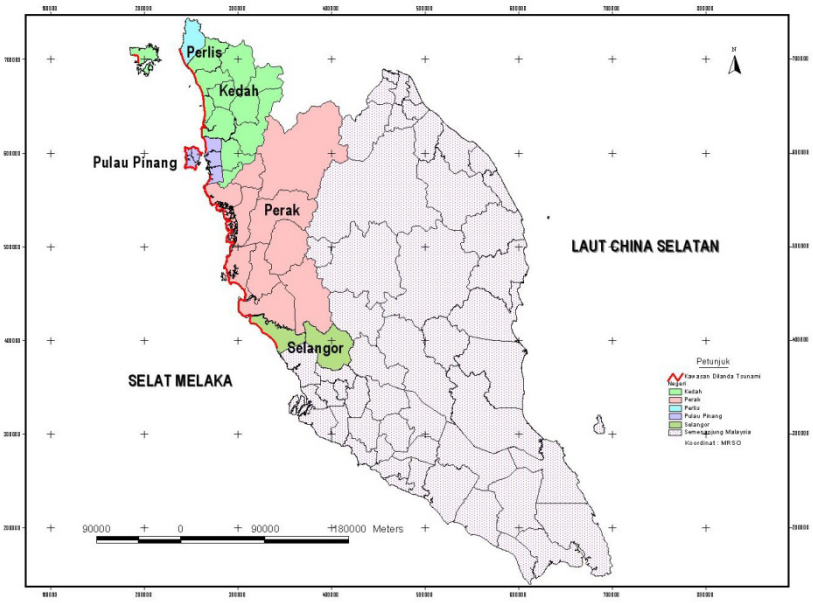

Figure 3: Tsunami affected area along west coast of Peninsular Malaysia (JPS, 2005).

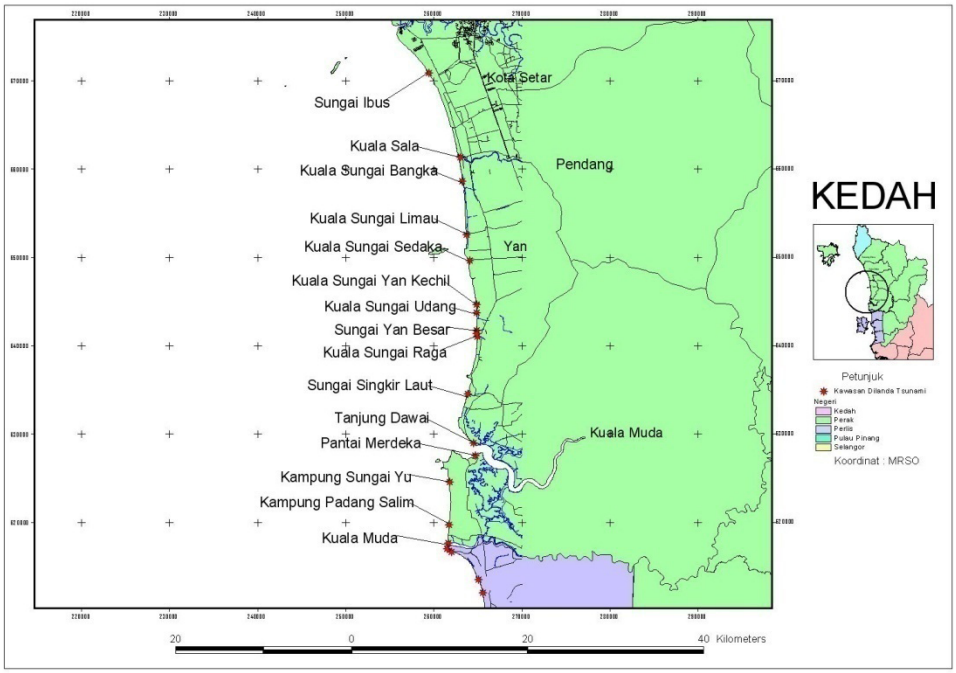

Figure 4: Tsunami affected areas along the Kedah coast of Malaysia (JPS, 2005).

METHODOLOGY

Vulnerability analysis is also known as vulnerability assessment. It is the process that defines, identifies, classifies and prioritizes the vulnerabilities in a system. Furthermore, vulnerability assessment can evaluate and predict the effectiveness of the proposed measures after they applied. The methodology described here to examine the vulnerability of West Coast of Peninsula Malaysia to earthquake hazards using GIS technology, readily available data, and a field work. The approach is meant to identify, and possible prioritized, issue or specific areas for further, more detailed engineering or benefit analyses. As such, many of the GIS layer are portrayed with ordinal rankings of very low, low, medium, high and very high. GIS based quantitative results are summaries of asset exposure and not loss estimates. While this study uses GIS technology to perform spatial queries and summarized data, jurisdictions lacking GIS technology can rely on the proliferation of online mapping applications to conduct analyses outline here. Finally, additional detail on the creation of each individual GIS layer can be found.

A GIS operates by using two types of data which is spatial data and attribute data. These data sets may then be combined in order to answer the questions being investigated. The spatial data of the study area has to be digitized from an original topographic map that will allow the user to identify individual buildings and open spaces were used as a base maps. The spatial data relates to each individual open space, road and stream. The attribute data (the parameters) such as population of identified from the agencies. Attribute and spatial data were input into the GIS in the form of multiple coverages. A major advantage of our approach relates to the very fine scale at which primary data has been collected. The data were collected during a ground based home to home, survey about the past event and also we check the elevation of the study area to make sure it can join with the spatial data.

GEOSPATIAL DATA PROCESSING

Land use Vulnerability

We assigned to each land use class as Land Use Vulnerability, ranging from 1 to 5. Highest vulnerability scores are assigned to urban areas follow up with agriculture, forest and mangrove. Table 2 shows the land use classes and we employed from Dall'Osso (2010). Figure 5 and figure 6 shows the map of land use of our study area.

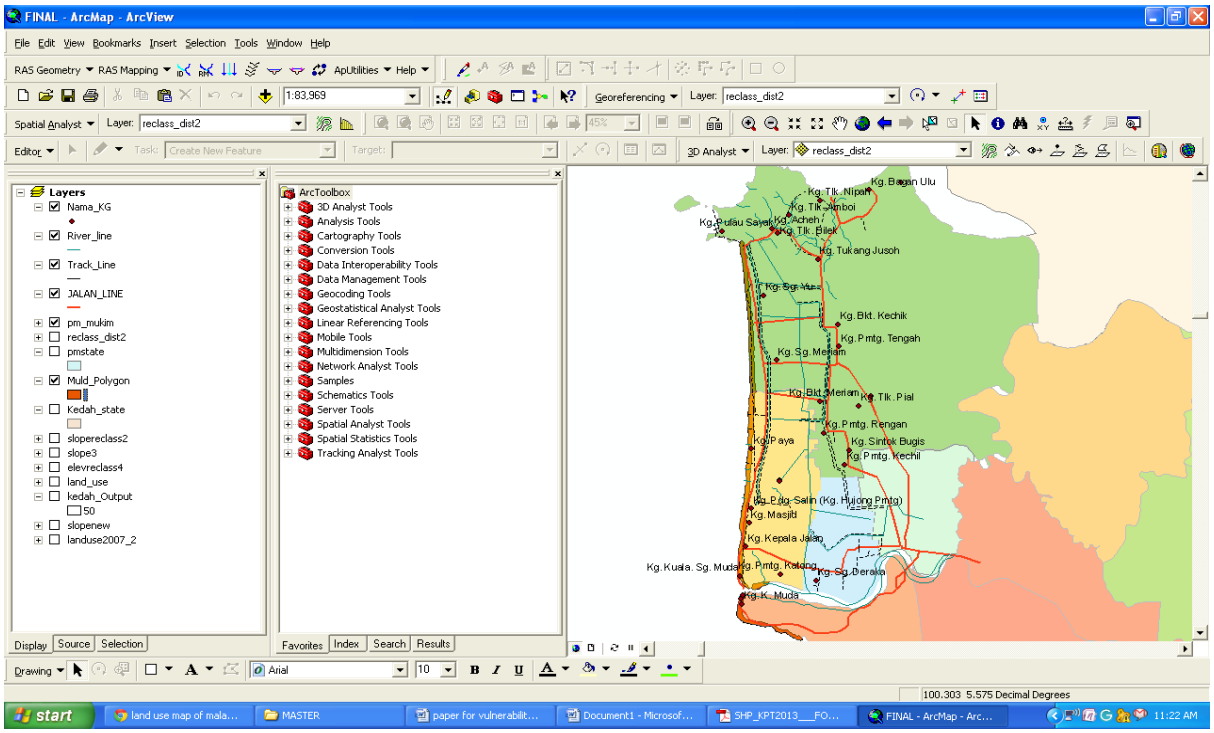

Figure 5: Land use map of Kota Kuala Muda.

Table 2: Land Use classes

Land Use Classes	Score
Urbanized area (high density)	Very high (5)
Urbanized area (low density)	High (4)
Agriculture, beaches, aquaculture pools, lake and fresh water	Medium (2)
Forest and mangrove	Very Low (1)

Topographic elevation

Topographic elevation is a primary condition to assess the tsunami vulnerability of a region. We used the Digital Elevation Model (DEM) from shuttle Radar Topography Mission (SRTM) to obtain the topographic elevation of the study area. The elevations were classified into five groups considering the tsunami run-up height at the coast (based on tsunami 2004). Table 3 show the elevation vulnerability score and Figure 7 show the map of elevation vulnerability.

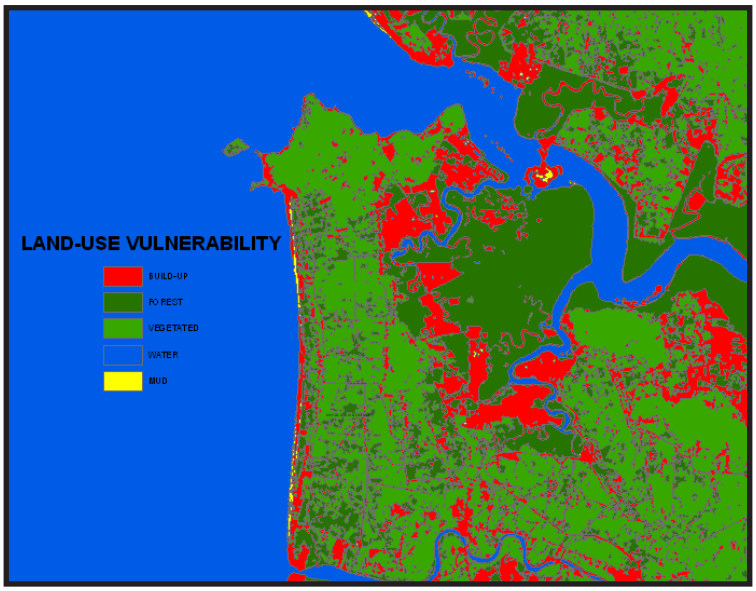

Figure 6: The vulnerability land use map.

Table 3: Elevation Vulnerability Score

Elevation (m)	Elevation Vulnerability / Score
0-5	Very high (5)
5-10	High (4)
10-15	Medium (3)
15-20	Low (2)
>20	Very Low (1)

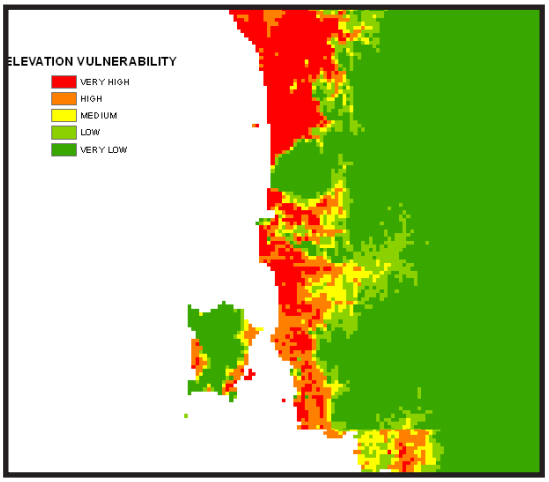

Figure 7: Map of elevation vulnerability

Slope Vulnerability

Tsunami run-up can be severe in areas of relatively flat topographic slope because the tsunami can easily flow onto flat areas, but may be detained by hills bordering the beach. We employed the slope classification of Hadibah (2012). Table 4 show the slope vulnerability score while Figure 8 show the map of slope.

Table 4: Slope vulnerability score

Slope (%)	Slope Vulnerability / Score
0-5	Very high (5)
5-10	High (4)
10-15	Medium (3)
15-20	Low (2)
>20	Very Low (1)

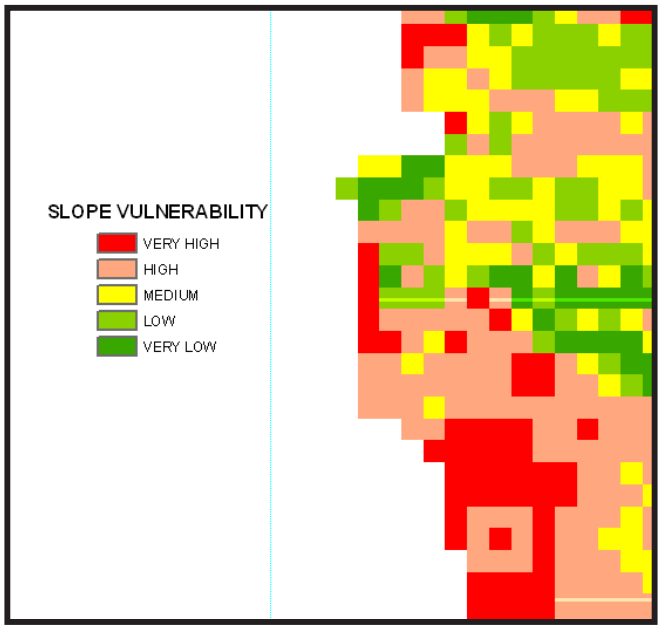

Figure 8: Map of Slope Vulnerability

Distance Vulnerability

Distance from the coastline is associated with the possible reach of tsunami. In general, vulnerability becomes higher when coastal distance decrease. Table 5 show the slope vulnerability score while Figure 9 show the map of slope.

Table 5: Distance Vulnerability from shoreline

Distance from shoreline (m)	Distance Vulnerability / Score
0-100	Very high (5)
100-200	High (4)
200-300	Medium (3)
300-400	Low (2)
400-500	Very Low (1)

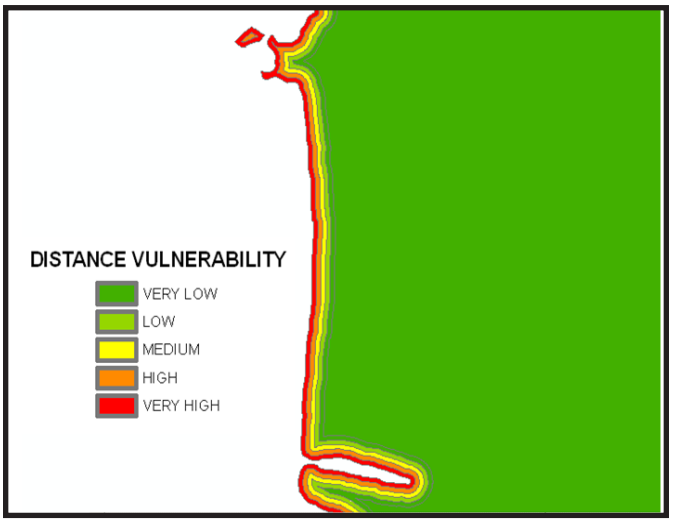

Figure 9: Map of Distance Vulnerability

CONCLUSION

In this paper, we described a multi-criteria analysis of tsunami vulnerability at a regional scale using geospatial variables within a GIS. We combined 4 geospatial variables (elevation, slope, distance, and land use) using GIS and create a tsunami vulnerability map for the West Coast of Peninsula Malaysia. Overlying the land-use classification on the tsunami vulnerability map showed that the urbanized area is particularly at risk if tsunami were to strike the study area. GIS analyses can be useful in a wide range of disaster assessment through the use of spatial functionalities such as topographic operation, buffer creation, raster reclassification and also intersection operations. Such approaches can aid in regional planning for management and mitigation of natural disaster, including tsunamis. However, such analysis can be limited by the availability of data necessary for estimating the risk of natural hazards.

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Najihah Remali*
Mohd Effendi Daud
Hairunnisa Md Arus
Faculty of Civil and Environmental Engineering
University Tun Hussein Onn Malaysia
86400 Parit Raja, Batu Pahat, Johor Darul Takzim.

**Corresponding author: ghah86@gmail.com*

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Preliminary Study on Utilizing Finely Ground Waste Glass in Cementitious Materials

Norsuzailina Mohamed Sutan, Ibrahim Yakub & Thian Jut -Wei

ABSTRACT

This study focuses on the effectiveness of using waste glass as cement replacements. Previous studies have shown that waste glass has pozzolanic characteristics that can potentially enhance the performance of cementitious materials such as concrete or mortar mainly due to their reaction with calcium hydroxide (C-H) to develop more of the strength-carrying compound in cement structure namely calcium silica hydrate (CSH). Glass modified mortar samples were prepared with water-to-cement ratio (w/c) of 0.5. Two types of glasses: Green and Clear glass were used as 10%, 20% and 30% cement replacement by weight. Samples were cured at room temperature (32° C) and 90% relative humidity. Powdered samples were prepared and tested at 28 days of hydration for pozzolanicity test using FT-IR. Results have shown that the optimum dosage for both Type I and Type II FGWG cement replacement is 10%. 10% of cement replacement of FGWG in cement paste indicates higher production of CSH compare to control sample which comply with the result from compressive strength of mortar. However, the strength of control mortar is higher.

Keywords: Finely Ground Waste Glass, Mortar, FTIR

ABSTRAK

Kajian ini memberi tumpuan kepada keberkesanan kaca buangan sebagai pengganti simen. Kajian terdahulu telah menunjukkan bahawa kaca sisa mempunyai ciri-ciri pozzolanic yang berpotensi boleh meningkatkan prestasi bahan produk simen seperti konkrit atau mortar disebabkan oleh tindak balas dengan kalsium hidroksida (CH) untuk meningkatkan pengeluaran kompaun pembawa kekuatan dalam struktur simen iaitu kalsium silika hidrat (CSH). Mortar ubahsuai dengan penambahan kaca halus telah disediakan dengan nisbah air kepada simen (w / c) 0.5. Dua jenis kaca: Kaca Hijau dan Jernih telah digunakan sebagai 10%, 20% dan 30% pengganti simen mengikut berat. Sampel telah diletakkan pada suhu bilik (32°C) dan 90% kelembapan. Sampel mortar dalam bentuk tepung telah disediakan dan diuji pada umur 28 hari penghidratan untuk ujikaji pozzolanisiti menggunakan FT-IR. Keputusan menunjukkan bahawa dos yang optimum untuk penggantian simen FGWG adalah 10% bagi kedua-dua kaca Jenis I dan II. 10% daripada penggantian simen FGWG dalam adunan simen menunjukkan pengeluaran CSH yang lebih tinggi berbanding dengan sampel kawalan yang mematuhi hasil daripada kekuatan mampatan mortar. Walau bagaimanapun, mortar kawalan mempunyai kekuatan yang lebih tinggi.

Kata Kunci: Kaca Buangan Bentuk Halus, Mortar, FTIR

INTRODUCTION

The disposal of waste materials presents a complex problem for many agencies worldwide therefore the need to recycle and reuse waste materials like glass is imperative. The efforts to use such non-conventional materials which are typically of local or regional origin in concrete will get a boost if there are systematic and comprehensive studies to quantify the performance of concretes containing such materials. A number of previous studies have examined the use of waste glass in concrete [4,5,6,7]. The use of waste glass as an aggregate replacement, inert filler or partial cement replacement has been investigated. Increasing applications of waste glass as coarse aggregates in concretes have been reported to decrease the mechanical properties, primarily because of a weak interface [8,10]. Also, larger particle sizes of glass (greater than 1.2–1.5 mm) are found to facilitate alkali–silica reaction (ASR) in concretes. Thus, when using ground glass or glass powder in cementitious systems, the particle size is not conducive for ASR to occur, but the potential of high alkali content of glass powder to cause deleterious expansions need to be accounted for [11]. The pozzolanic properties of glass powders also have been explored in some studies. Recent studies have investigated the influence of varying dosages of fine glass powder on cement hydration, and have modeled the degree of hydration of cement pastes containing glass powder [1,2,3,9]. The mechanical properties of the concretes containing glass powder and its alkali–silica reactivity have been investigated [11]. However, there is a lack of information on the overall durability performance of glass powder modified concretes, and how it compares with the durability of concretes containing other supplementary cementing materials. This study is an attempt in that direction. The resistance of glass powder modified concretes to chloride penetrability and moisture ingress, and those of mortars to alkali–silica reactivity are studied in detail, and the performance is compared to mixtures containing similar replacement levels of supplementary cementing materials. Such a quantitative comparison between glass powder and supplementary cementing materials modified concretes is expected to help material designers in choosing optimal dosages as well as lead to better confidence in the use of glass powder in concrete.

MATERIALS AND METHODS

Materials

The two types of waste glasses were chosen for this research: Clear Glass (Type I) and Green Glass (Type II). The chemical composition of glass is given in Figure 1.

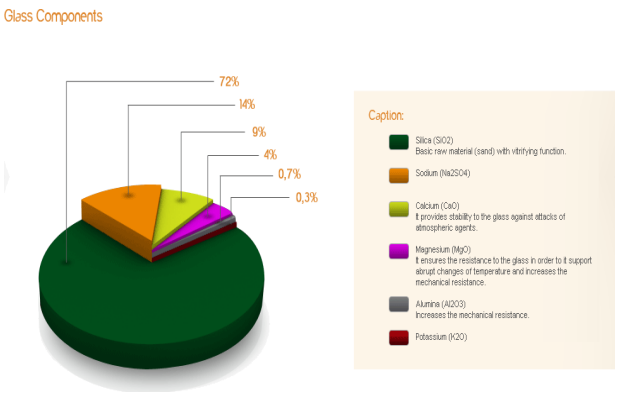


Figure 1: Chemical Composition of Glass

Cement used was Ordinary Portland Cement (OPC) (ASTM Type 1 recognized by ASTM C150) manufactured by Cahaya Mata Sarawak Cement Sdn. Bhd (CMS) and it exceeded the quality requirements specified in the Malaysian Standard MS 522: Part 1: 1989 Specifications for OPC. The chemical and mineralogical characteristics of the OPC binder are given in Fig. 2.

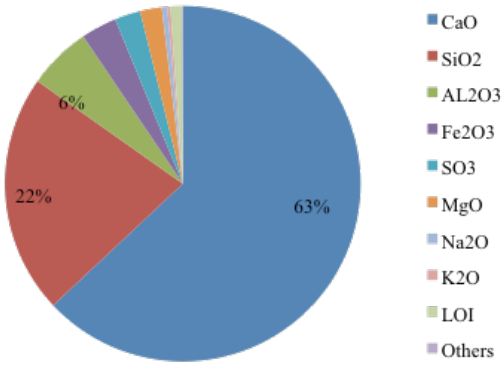


Figure 2: Chemical Composition of OPC

To study the pozzolanicity of glass modified mortar, comparative physicochemical analyses were performed using Compressive Strength Test (CS) and Fourier Transform Infrared Spectroscopy (FTIR) The mix proportion was set at 1:0.4:1.67 for all samples that were casted into Universal Container 30ml, 28 X 85mm for PT, SCM and SEM, and 150 mm X 150 mm X 150 mm cubes for CS test. All samples were dry-cured in the concrete laboratory with average temperature (T) of 32° C and average relative humidity (RH) of 90%. WGM mortar samples were prepared with water to cement ratio of 0.5 and 10%, 20% and 30% of type of glass 1 and type of glass II cement replacement by weight.

TEST METHODS

FTIR

IR spectroscopy retains analytical technique to obtain spectra from a very wide range of solids, liquids and gases. It was used to determine the presence and shifting pattern of Calcium Silicate Hydrate (CSH) and Calcium Hydroxide, $Ca(OH)_2$ (CH).

Compressive strength test

28-day CS test was performed according to BS 1881-116 (1983) on 150 mm cubes samples. It was used to determine the maximum compressive load that a sample can carry per unit area. The compressive strength gives the overall picture of the quality of concrete.

RESULTS AND DISCUSSIONS

Strength development using compressive strength test

The compressive strength results of 212μm glass powders mortars are plotted in Figure 3 and 4. It can be observed that in case of cement replacement by the glass powder, the reduction in compressive strength increases with the level of cement replacement.

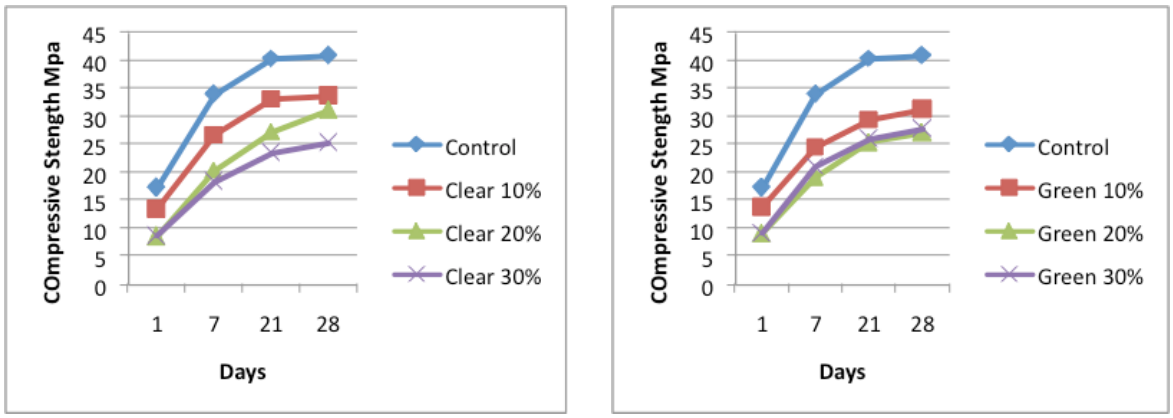


Figure 3: Compressive strength development of FGWG mortar

Figure 3 shows that increase in compressive strength is obtained with the reduction of the percentage of FGWG replacement. For both type of glass, the percentage replacement of 10% indicates the highest strength development. This shows similar result from (Pereira, 2004). However, Type I mortar (specific surface of about 355 kg/m^2) indicates higher strength development compared to Type II mortar (of about 445 kg/m^2). The different result in comparison to (Pereira, 2004) is due to the different in particle size used. The addition amount of chromium oxide as colorant in Type II in Malaysia differs from Covilhã, Portugal. Therefore, the strength of Type I mortar shows slightly higher strength than Type II.Samples with 20% and 30% of replacement by FGWG show lower strength due to the reduction of amount of cement in mix proportion. As cement acts as a binder for concrete, the lower the proportion of binder will reduce the strength of the FGWG mortar.

Characterization of CH and C-S-H using Fourier Transform Infrared Spectroscopy (FTIR)

For the Type I sample:

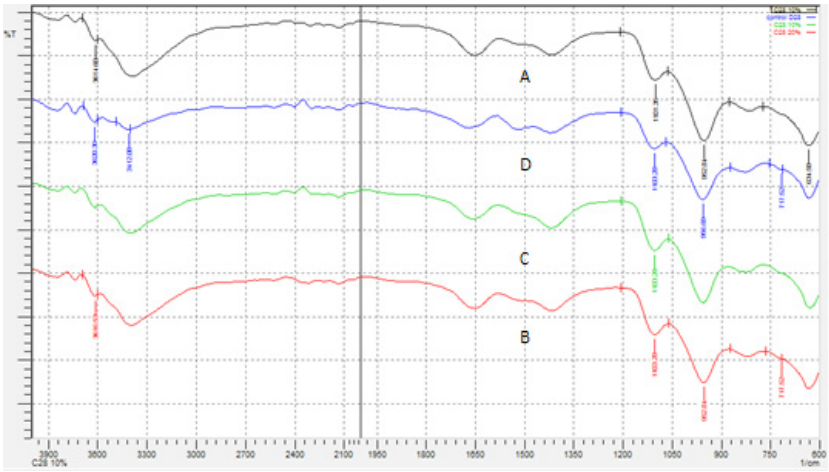


Figure 4: FT-IR Spectra of Cement Paste Sample at 28 days with (A) 10% Type I (B) 20% Type I (C) 30% Type I (D) Control

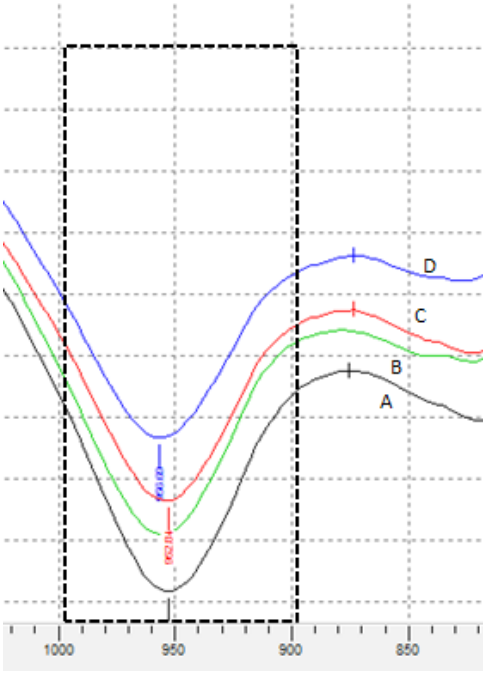


Figure 5: FT-IR Spectra centre around 970cm^{-1} of Cement Paste Sample at 28 days with (A) 10% Type I (B) 20% Type I (C) 30% Type I (D) Control

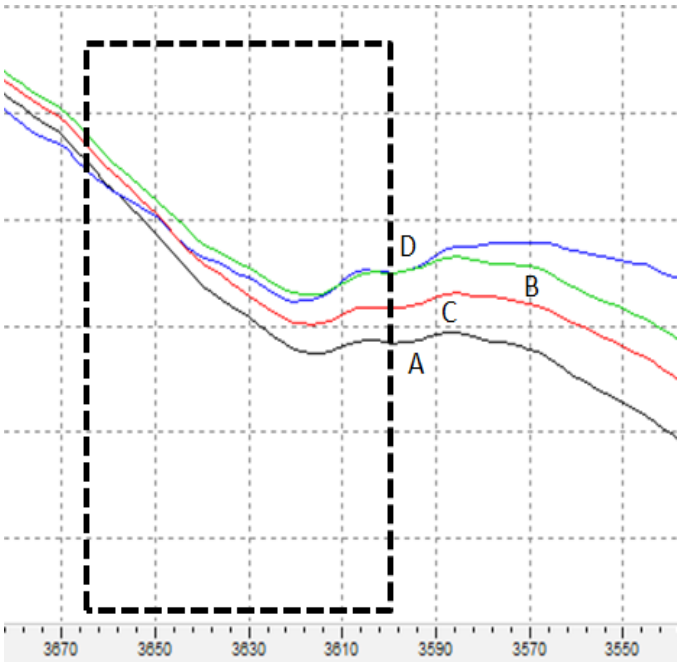
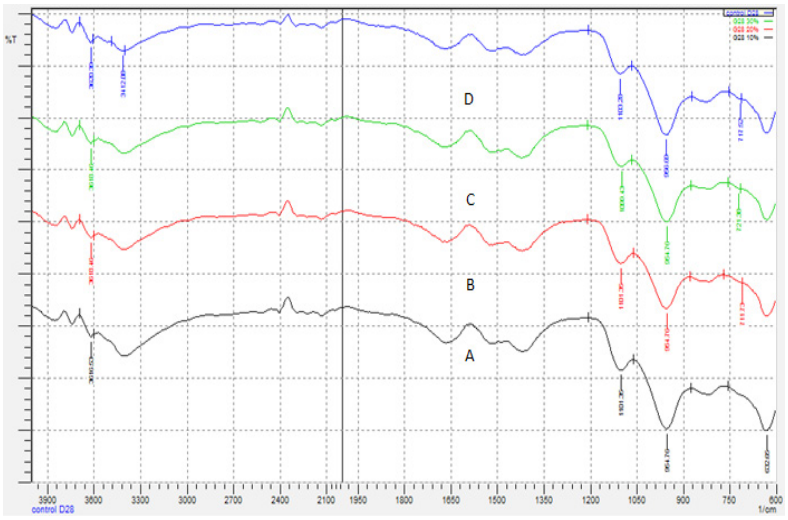


Figure 6: FT-IR Spectra centre around 3615cm^{-1} of Cement Paste Sample at 28 days with (A) 10% Type I (B) 20% Type I (C) 30% Type I (D) Control



For the Type II sample:

Figure 7: FT-IR Spectra of Cement Paste Sample at 28 days with (A) 10% TypeI I (B) 20% Type II (C) 30% Type II (D) Control

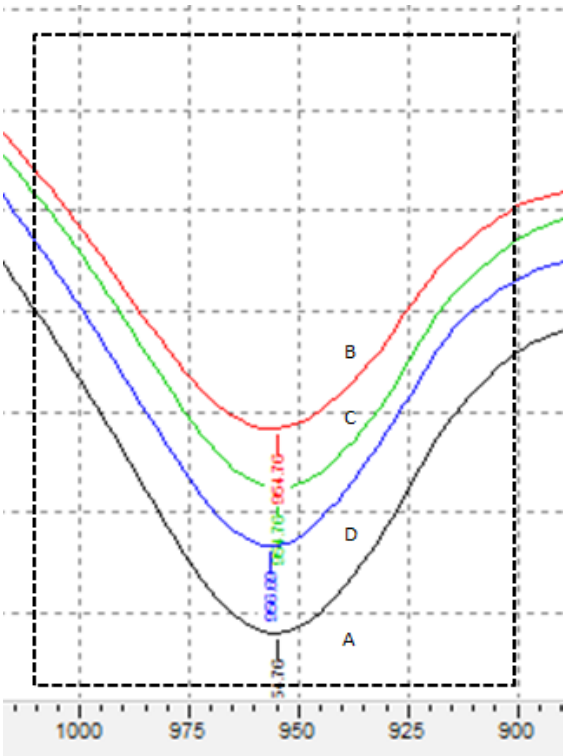


Figure 8: FT-IR Spectra centre around 970cm^{-1} of Cement Paste Sample at 28 days with (A) 10% Type II (B) 20% Type II (C) 30% Type II (D) Control

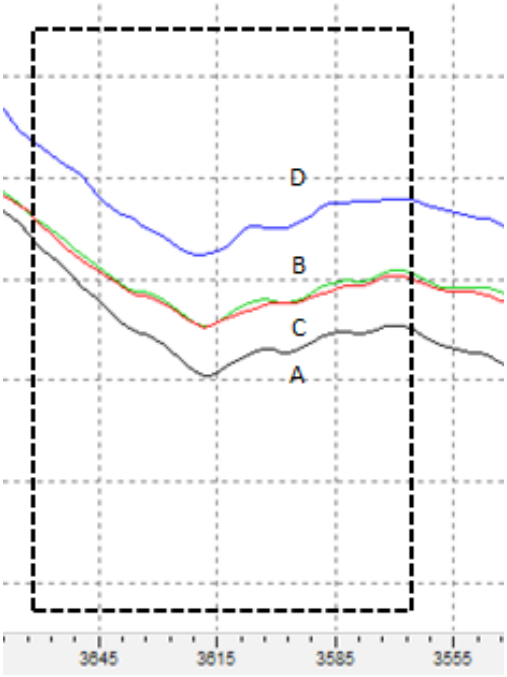


Figure 9:FT-IR Spectra centre around 3615cm^{-1} of Cement Paste Sample at 28 days with (A) 10% TypeI I (B) 20% Type II (C) 30% Type II (D) Control

From the FT-IR spectra of FGWG in cement paste (Figure 4 and 7), a small sharp band appeared at center around 3630cm^{-1} indicating the presence of $Ca(OH)_2$ in O-H stretching. Strong bond centered around 970 cm^{-1} (Si–O asymmetric stretching (ν3) vibration) shows the formation of CSH. Comparing result obtained in Type I cement paste in Figure 5, the slope for 10% Type I is the steepest among all the samples indicating strong bonding of O-H stretching. This also implies more production of CH on day 28 in all Type I cement pastes. This may be due to the addition ns had increases the hydration rate and caused more CH to be formed. Sample with 20% and 30% of Type I have lower hydration rate due to the increase in percentage of cement replacement. Thus, less production of CH occurs. This can also be observed in Type II cement paste in Figure 6. Sample with 10% Type II (Figure 8) also shows similar result as Type I.

Asymmetric stretching of v_3 band in 10 % Type I and Type II indicate higher intensity than control sample. This can be detected by observing the intensity of the slope. The steeper the shape of the slope will result stronger bonding and presence of CSH at frequency 970cm^{-1}. In Figure 6 and 9, both 10% FGWG replacement result in more CSH produced. For samples of 20% and 30%, more flat or softer intensity can be observed to control sample indicating less CSH production. This may due to the agglomeration of FGWG that prevent homogenous dispersion in the cement paste and hence participation in hydration reaction.

CONCLUSION

The optimum dosage for the FGWG cement replacement is 10%. This applies for both Type I and Type II glass. 10% of cement replacement of FGWG in cement paste results in higher production of CSH compared to control sample which complies with the result from compressive strength of mortar. However, the strength of control mortar is higher. This may be due to less amount of

cement use as binder when replaced by FGWG. Pozzolanic reaction occurs as the production of CSH increased due to the higher surface area of FGWG particle. Besides that, the addition of FGWG also improved the hydration rate of cement paste and produced more CH in early stage of hydration.

ACKNOWLEDGMENT

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Norsuzailina Mohamed Sutan, Ibrahim Yakub and Thian Jut -Wei
Faculty of Engineering
Universiti Malaysia Sarawak
Kota Samarahan, Sarawak
msnorsuzailina@feng.unimas.my

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New Process of Developing Nanocrytalline Fecr for Fuel Cell Application

Darwin Sebayang, Maizlinda Izwana, Asraf Othman, Dafit Feriyanto, Deni S. Khaerudini & Hendi Saryanto

ABSTRACT

FeCr alloy were developed as a replacement of ceramic interconnect, they are favored because their moderate oxidation resistance and fairly good corrosion resistance provided by the formation of Cr_2O_3 scale in the presence of oxidant. Therefore the FeCr alloy compatible for SOFC application. The aim of this project is to conduct the research on the effect of each process in the high temperature oxidation for SOFC application of FeCr alloy. The new process of this research is combining the ball milling process with holding time 15 h, 20 h, 40 h, 60 h, and 80 h, hot pressing at pressure of 25 MPa and temperature of 1000 ^{0}C with sample name HP1000, spark plasma sintering at pressure of 10 MPa and temperature of 800 ^{0}C and 900 ^{0}C with sample name SPS800 and SPS900 and surface treatment via ion implantation by La as implant to obtain material that having good electrical resistance, good microstucture and good in high temperature oxidation for SOFC application. In the ball milling process the smallest crystallite size in milling time 60 h, and the SEM micrograph not identifies the crack and voids in the surface of consolidated specimens. Surface treatment via La-implanted effective to obtain a better result at consolidation process, surface treatment process and electrical analysis than commercial materials. The contribution of La implantation is also essential for the effectiveness of internal to external oxidation transition.

Keywords: FeCr, SOFC, new process and ion implantation.

INTRODUCTION

Fuel Cell is generally regarded to be the central importance for the transformation the so-called hydrogen economy. One of the promising fuel cell systems in future is Solid Oxide Fuel Cell (SOFC) due to the high –density power generation device. Solid oxide posses sufficiently high ionic conductivity at the elevated temperature so that SOFC must operate at the temperature range of 800- 1000^{0}C. The material in nano range size have many advantages to becoming SOFC application such as enhanced diffusivity, improved ductility, reduced density and modulus, high electrical resistance, high thermal expansion coefficient, lower thermal conductivity, and superior soft magnetic properties if in comparison with conventional coarse-grained materials. Exploration of new energy resources seems to be challenging task for the future. One of the most promising and attention fuel cell systems seems to be solid oxide fuel cell (SOFC) because of its potential for becoming an efficient and high energy-density power generation device [1, 2].

Metallic materials as SOFC application have many advantages of a high electronic conductivity, lower cost and easier fabrication [2]. Metal alloy are not capable of performing adequately over extended periods. This is challenging because the interconnector is exposed to both oxidizing condition at the cathode and reducing condition at the anode. Metal alloy with specific physical and mechanical properties and retains their strength at the elevated temperature that could be applied successfully as a fuel cell interconnects.

Metal alloys have long been considered as potential candidates for high temperature application because their strength to weight ratio [3]. New FeCr based alloys have recently been developed specially for SOFC applications. These materials seems to be sufficiently good for most of the envisaged SOFC application, however, its still important to improving the result with designed the composition of FeCr alloys.

Mechanical alloying had been introduced with ball milling process, and SPS technique to produce the bulk FeCr alloy, since the process is capable of control to producing many metallic alloy with a perfectly controlled degree of densification. Microstructure with near theoretical density over 99% at relatively lower sintering temperature (200 to 500 ^{0}C) than the temperature using in conventional HP process [4]. SPS sintering can be completed in a short period of 5 to 20 minutes including temperature rise and holding times [4].

Ion implantation method used as surface treatment process, ion implantation for the modification of surface properties of materials by insertion of accelerated atoms within the firs atomic layer into solid substrate [3]. Ion implantation is widely used to modify the oxidation behavior to the surface of the alloys, Ion implantation will allow the introducing of a controlled reactive element (RE) concentration into the alloys surface to modification of the corrosion behavior of the metal surface. The minor addition of RE such as La, Y, Ti, Hf and Ce could significantly improve the spallation resistance of these oxide scale under oxidizing and reducing conditions and inhibits further by isothermal and thermal cycling oxidation [3, 5].

The main aim of this research to investigate the effects of each process in the high temperature oxidation for SOFC application. To more understanding, the available high Fe and Cr ferritic model alloys were prepared into the test program. Characterization by using X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy dispersive X-ray spectroscopy (EDX) to investigate the microstructure, phase and the formation of the oxide layer.

METHODOLOGY

Preparation material on the research

The raw material is commercially available powders of iron (320 mesh and purity >99.9%) and chromium (320 mesh and purity >99.8%). The nominal weight composition of alloyed Fe and Cr closed to 80:20 wt%.

Preparation

Milling

Milling process has done with the firs stage is the mixtures were sealed in a 250 ml hardened stainless steel vial. The ratio was fixed 20:1 weight ratio of ball to powder. Mechanical alloying

process was conducted in different milling time for 7 h, 15 h, 20 h, 40 h, 60 h, and 80 h in RETCH PM400 planetary ball mill and the rotation speed of 300 rpm.

Hot pressing and SPS process

The consolidation process there are three parameter should be specified that temperature, compaction pressure and soaking time of the process. Hot pressing were poured into a cylinder shape and pressed at 25 MPa with a diameter of 33 mm and thickness of 4-5 mm by using vacuum hot press machine and the sintering process was conducted in temperature 1000 ^{0}C at heating and cooling rate of 20 ^{0}C/min with the holding time 45 minutes. Spark plasma sintering process was conducted with temperature of 800 ^{0}C and 900 ^{0}C. SPS process was conducted by using the SPS Model 10-3 apparatus at a loading pressure of 10 MPa and cooling rate of 400^{0}C/min with significant short holding time of 5 minutes.

Surface treatment process

Ion implantation of lanthanum dopants with nominal doses 1x10^{17} ions/cm^2 was undertaken using 10 KeV acceleration potential with beam current density of 10 μA/cm^2 and 20 kV extraction voltages.

Oxidation experimental

The oxidation test must be examined under conditions which resemble SOFC operational conditions. In this study Oxidation test carried out using a resistance box furnace in air atmospheric pressure to cover the extreme conditions. In this work the cyclic oxidation test was conducted at 900 ^{0}C and 1100 ^{0}C. The experiment was designed at 5 cycles which each cycle consist of 20 h of soaking period. The sample weight change which measured by an electronic microbalance with resolution of 0.01 mg were recorded after each cycle in order to plot the weight gain and oxidation graph.

ANALYSIS

Determine of crystallite size and strain of materials.

Determining the crystallite size and strain of milled and unmilled powders was conducted by the Williamson-Hall Method [6]:

$$\varepsilon_{strain} = \frac{B}{4\tan\theta} \tag{1}$$

$$B\cos\theta = \frac{K\lambda}{D} + 4\varepsilon\sin\theta \tag{2}$$

Where: D = Volume weighted crystallite size
K = scherrer constant (0.87-1.0)

λ = the wave length of the radiation
B = FWHM of refletion peaks located at 2
ε_{strain} = weight average strain

SEM analysis.

SEM carried out in laboratory of materials with brands machine is SEM JEOL JSM-6380LA which equipped with EDS. SEM is very high image resolution of the sample surface, the resolution in about 1-5 nm.

XRD analysis

The XRD analyses were determine using a Bruker model D8 advance XRD. From Brags angle (2) in the range of 30° to 90° at a scene rate of 0.02°/min to provide adequate sampling of the peaks height (FWHM).

Electrical resistivity analysis.

Electrical resistivity was evaluated by using the standard two point electrical measurement to obtain electrical current-voltage curve of the oxidized samples. The resistivity was conducted under the static air condition after exposing thermal cycles for 100 h of different oxidation temperatures. The measurement were carried out at the Microelectronics and Nanotechnology - Shamsudin research centre (MiNT-SRC) of UTHM. The various samples are designated as shown in following Table 1.

Table 1: The investigated alloy designation

Alloy designation	Sample name	Major features
$Fe_{80}Cr_{20}$ 15 h	$Fe_{80}Cr_{20}$ 15 h	Milled 15 h and hot compacted
$Fe_{80}Cr_{20}$ 20 h	$Fe_{80}Cr_{20}$ 20 h	Milled 20 h and hot compacted
$Fe_{80}Cr_{20}$ 40 h	FC-1	Milled 40 h hot compacted and SPS processed
$Fe_{80}Cr_{20}$ 60 h	FC-2	Milled 60 h, hot compacted and SPS processed
$Fe_{80}Cr_{20}$ 80 h	FC-3	Milled 80 h, hot compacted and SPS processed
Commercial Ferritic steel	FC-4	Commercial Ferritic Steel
Fe powder	FC-5	Fe Powder
Cr powder	FC-6	Cr powder
$Fe_{80}Cr_{20}$ 40 h	FC-1La	FC-1 Implanted with La
$Fe_{80}Cr_{20}$ 60 h	FC-2La	FC-2 Implanted with La
Commercial Ferritic steel	FC-4La	FC-4 Implanted with La

RESULT AND DISCUSSION

Crystallite size and strain of ball milled powders can be seen following Table 2.

Table 2: Evaluation ball milled powders of $Fe_{80}Cr_{20}$

Unmilled and Milled powder	crystallite size (nm)	Strain (%)
$Fe_{80}Cr_{20}$ 15 h	57.77	0.0022
$Fe_{80}Cr_{20}$ 20 h	11.45	0.0041
FC-1	6.38	0.0009
FC-2	5.82	0.0017
FC-4	9.36	0.0022
FC-5	198	0.0038
FC-6	198	0.002

As shown in table 1 the unmilled and milled powders of $Fe_{80}Cr_{20}$ with the increasing milling time the size of the structure starts to decrease successively due to heavy plastic deformation [7]. Starts of plastic deformation crystallite size $Fe_{80}Cr_{20}$ in milling time of 80 h and smallest crystallite size in milling time of 60 h with 5.82 nm and strain of 0.0017%.

SEM on Consolidated Powders

Consolidation process an effective to removal porosity with the hot compaction processes that removing air from the powder body in order to obtain good interparticle bonding. The spark plasma sintering can to obtain a part having both high densities as well as to desire microstructure. SEM image for consolidated powders can be seen in Figure 1.

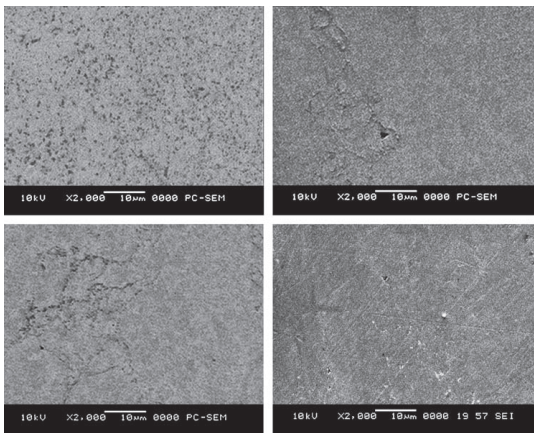

Figure 1 SEM images for the as consolidated (a) FC-1 (b) FC-2 (c) FC-3, and (d) FC-4

In this study, among the consolidation technique: SPS and HP, the SPS sample resulted in finer crystallite size than HP process which influenced by the reduction in an extensive grain

growth during sintering process. The results of the crystallite size calculation are also shown in Table 2. In HP sintering, it is more time consuming in order to achieve the sintered/consolidated alloy. The SPS samples were sintered with lower sintering temperature than HP process. However, the densification takes place much faster in the SPS than in HP process. The microstructure morphology of FC-1, FC-2, and FC-3 finer morphology structure than the FC-4, it can be seen from Figure-1 not identified the cracks and voids on consolidated specimens.

Oxidation resistance of La-implanted and unimplanted specimens

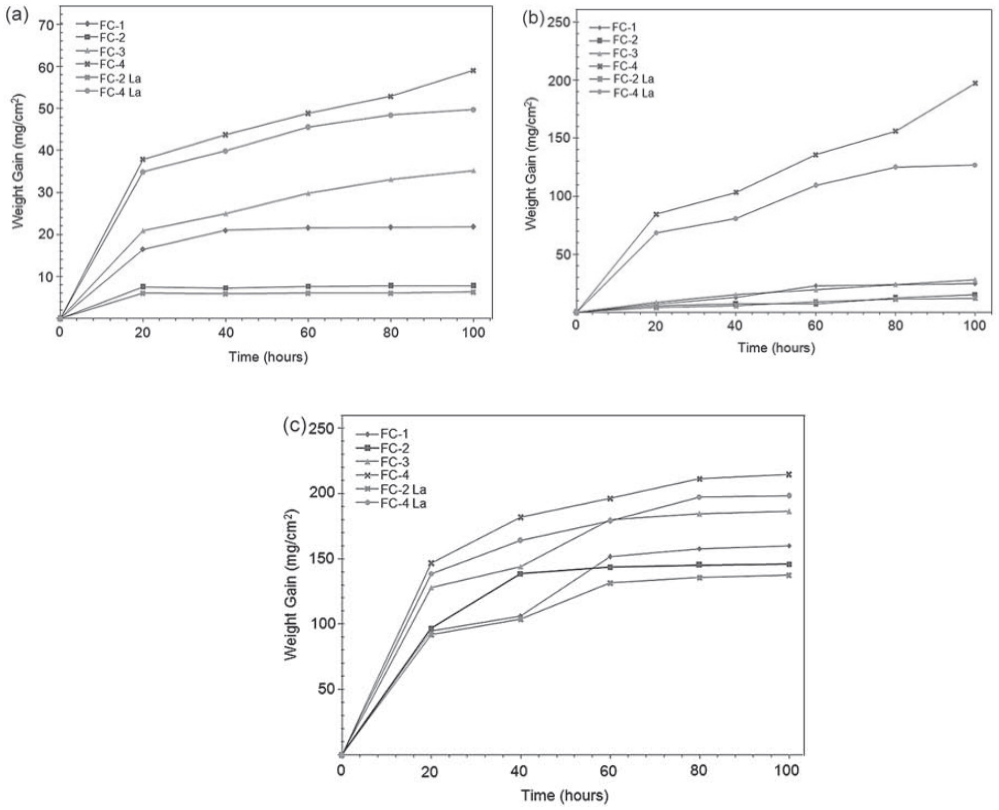

Figure 2: Mass gain as function of oxidation time for all the specimen La-implanted and unimplanted alloys oxidized at (a) 900 ^{0}C, (b) 1000 ^{0}C, (c) 1100 ^{0}C in air for 100 h

Figure 2 shown the mass gain for the sample oxidized at (a) 900 ^{0}C, (b) 1000 ^{0}C, (c) 1100 ^{0}C in air for 100 h of La-implanted and unimplanted. La-Implanted to all studied sample had an effect of reduction of oxidation. The mass gain for La-implanted alloy is reduced better than unimplanted alloy. The contribution of La implantation is also essential for the effectiveness of internal to external oxidation transition to form a continuous and slow growth oxide (chromium) layer. It also in oxidized at 1000 ^{0}C and 1100 ^{0}C in air for 100 h the effect of La-implanted better than unimplanted for reducing the mass gain of the $Fe_{80}Cr_{20}$ alloys. The parabolic oxidation model assumes that the oxidation process in diffusion limited. As none of the alloys, resulted in a parabolic rate constant within the required range, therefore further modifications are required in order for the alloys tested to be suitable for SOFC applications.

XRD pattern of La-implanted and unimplanted specimens

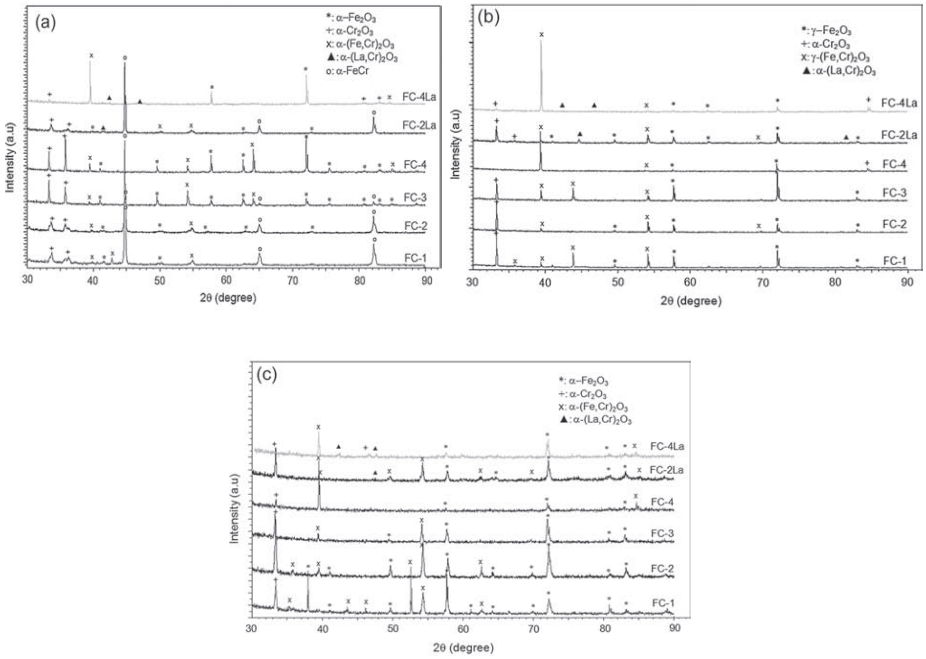

Figure 3: XRD patterns of La-implanted and unimplanted alloys at (a) 900 ^{0}C, (b) 1000 ^{0}C, (c) 1100 ^{0}C in air for 100 h

The XRD peaks also show the predominate phase in the oxide scales are Cr_2O_3 and $(Fe,Cr)_2O_3$ and also very weak peaks of Fe_2O_3. Meanwhile, the weak diffraction peaks observed the existence of La_2O_3 or $LaCrO_3$ only for the oxidized implanted samples. The XRD pattern for the unimplanted sample also indicated that mainly Cr_2O_3 is formed. Very week peaks of Fe_2O_3, $(Fe,Cr)_2O_3$ are also observed as this unimplanted samples Formation of Cr was very essential which offer potential as the protective oxide in order diminished the growth rate of oxide scale which usually spell under SOFC temperature operation condition [8]. The phenomenon may accrued due to the high oxygen pressure provides a driving forces for iron diffusion through the Cr scale as the interface oxide layer to form iron oxide. The early oxidation process with the oxide scale is very thin, the reaction speed is mainly controlled by the reaction speed at the interface until the final oxidation process is mainly controlled by diffusion because the increasing thickness of the scale by the path widens of oxygen diffusion. After the oxidation 1000 ^{0}C and 1100 ^{0}C the $Fe_{80}Cr_{20}$ alloys phase is no longer detected at all oxidized samples as the oxidation kinetics of the samples also increasing higher than the oxidation kinetics at 900 ^{0}C.

Microstructure morphology analysis with SEM and EDS result

Implanted specimens, the main oxide scale obtained were α-$(Fe, Cr)_2O_3$, α-Fe_2O_3, α-Cr_2O_3, and small amount of α-$(La, Cr)_2O_3$. The major phases of specimens after oxidation for 100 h at 1000 ^{0}C are illustrated at Fig. 5. For the unimplanted specimen, the main oxide scales obtained were -Fe_2O_3 and α-$(Fe, Cr)_2O_3$; and the minor oxide scale was α -Cr_2O_3. For the implanted specimens,

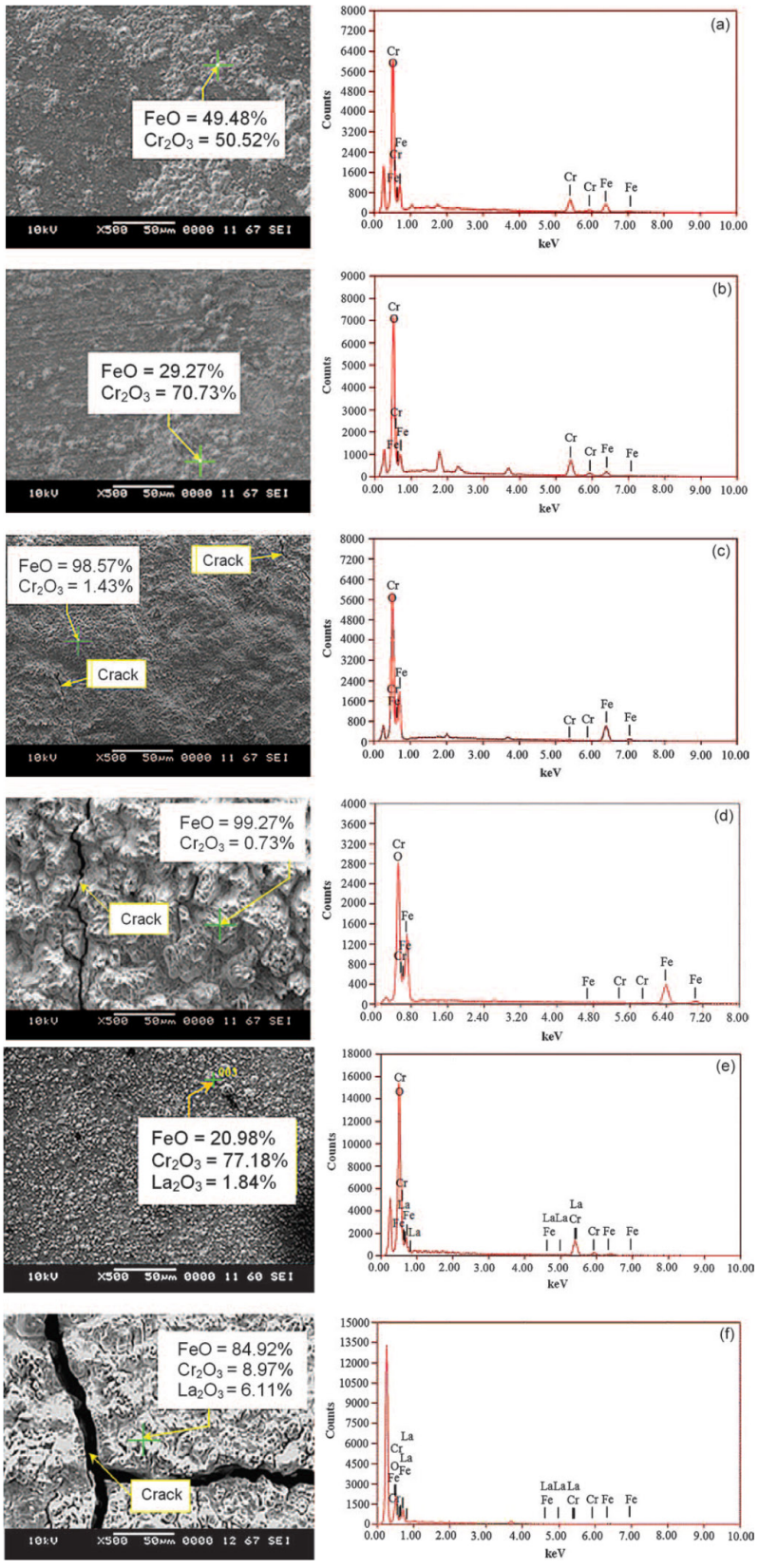

Figure 4: SEM oxide morphology and EDS results of the specimens after oxidation at 900 ^{0}C for 100 h: (a) FC-1, (b) FC-2, (c) FC-3, (d) FC-4, (e) FC-1La, and (f) FC-4La

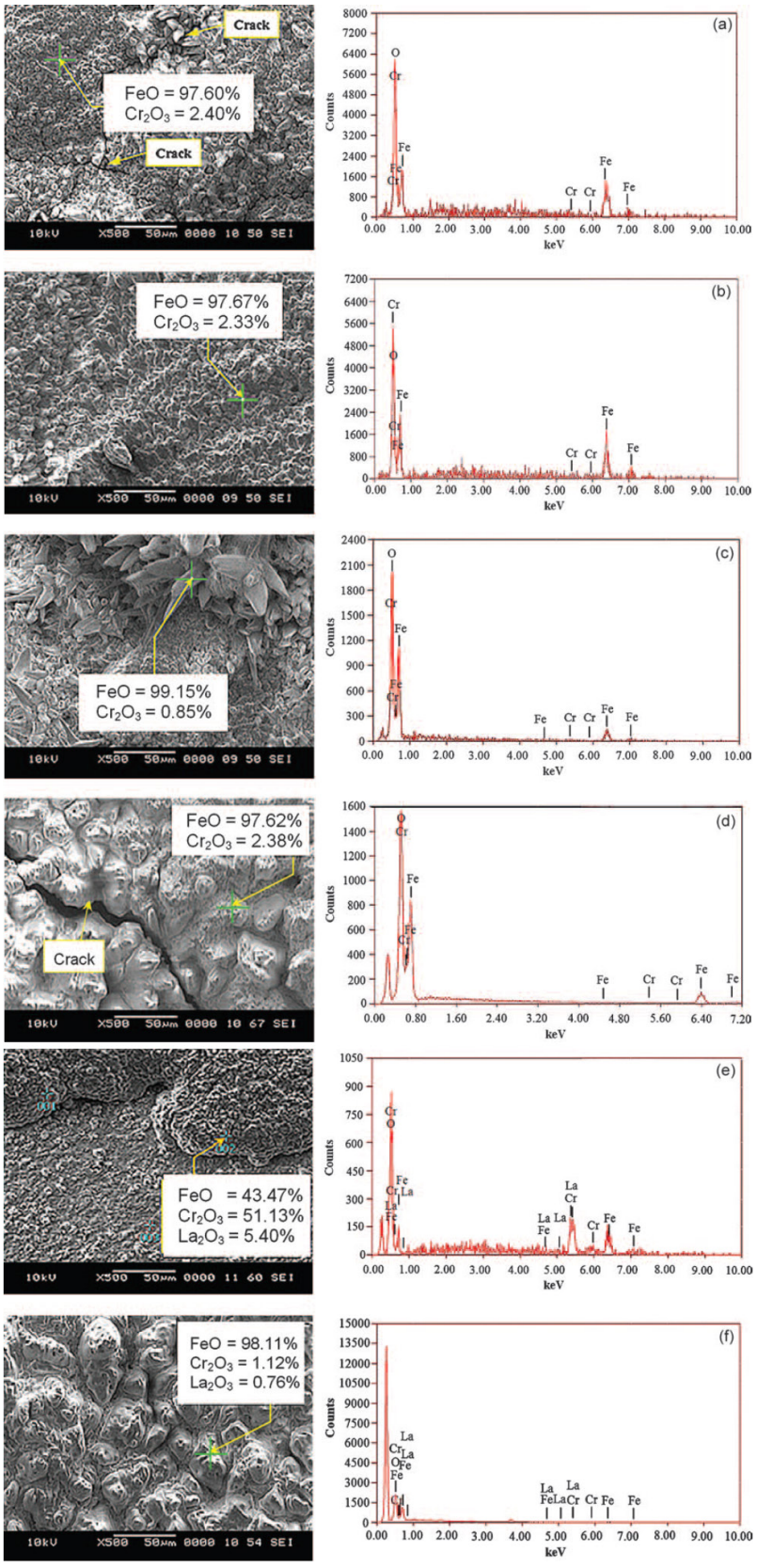

Figure 5: SEM oxide morphology and EDS results of the specimens after oxidation at 1000 ^{0}C for 100 h: (a) FC-1, (b) FC-2, (c) FC-3, (d) FC-4, (e) FC-1La, and (f) FC-4La

the main oxide scales obtained were -(Fe, Cr) $_2O_3$, α -Fe_2O_3, α-Cr_2O_3, and small amount of α-(La, Cr) $_2O_3$. After 100 h of exposure at 1100 ^{0}C, the main oxide scale consisted of α-Fe_2O_3, while α-(Fe, Cr)$_2O_3$ and α-Cr_2O_3 was obtained as the minor oxide scale for the unimplanted specimens. The major phases of the implanted specimens after oxidized for 100 h at 1100 ^{0}C were α-(Fe, Cr) $_2O_3$, α-Cr_2O_3, -Fe_2O_3, and minor phase of α-(La, Cr) $_2O_3$. The appearance of Fe_2O_3 as a thin layer at the scale/substrate interface reflects the higher thermodynamic stability of this oxide as compared to Cr_2O_3 for specimen FC-3 and FC-4 after oxidation at 1100 ^{0}C. For the as developed FeCr specimens, both unimplanted and implanted at 900 ^{0}C, it is evidenced that growing oxide peaks but still shows the peaks of the original specimens. It indicates that the oxidation growth at 900 ^{0}C on the surface of the as developed FeCr specimen that occurred but not significant [9].

SEM cross section

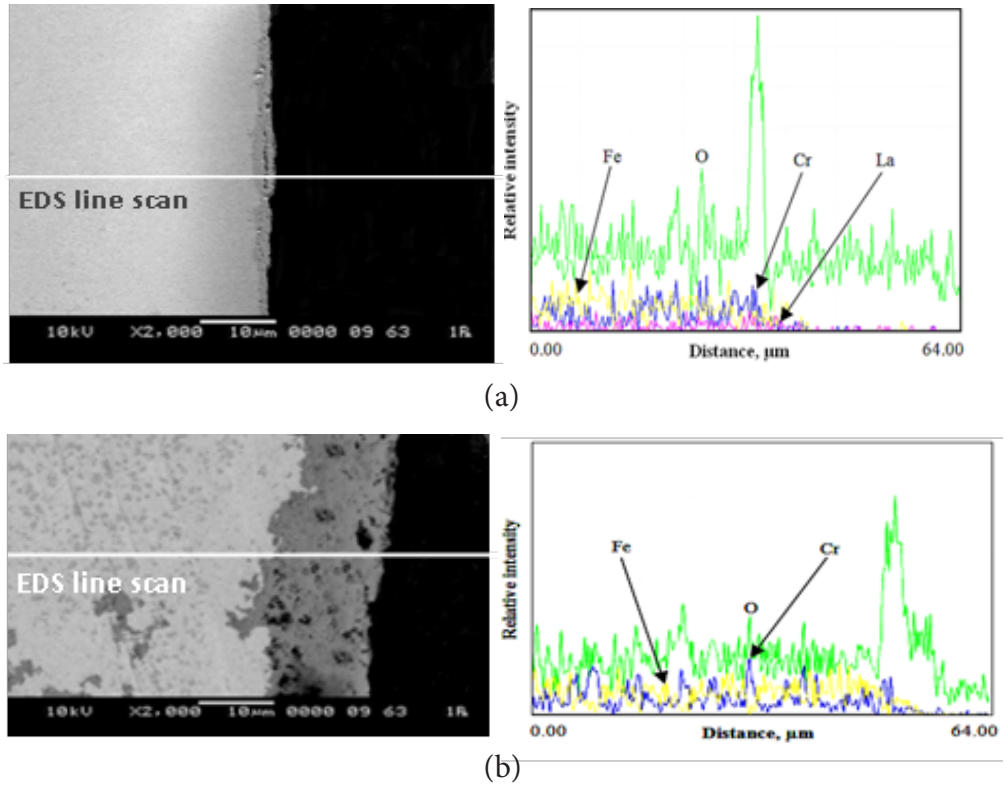

Figure 6: SEM Cross-section and EDS line scan profile of the implanted (a) SPS800 (b) Unimplanted HP1000 oxidized at 900 ^{0}C.

In the line scan show that O element peak present in the implanted SPS800 become decreased as indicated in figure 6-a. For the unimplanted sample, the thickness of FeCr HP1000 is approximately three times compared the thickness of SPS800 sample. As expected the lanthanum implanted samples exhibits a relative dense and continuous scale with relative strong adhesion to the substrate.

In the implanted and unimplanted samples, the cross section SEM after oxidation were better in the scale thickness, adherence, morphology, lower oxidation growth and clearly the oxide scale formed on substrate surface, the spallation crack and porous tend to accrued seriously. The

oxidation behaviour is sensitive to the microstructural characteristics of the materials, the improve oxidation resistance in the nanocrystalline because improved adhesion of passive film formed over nancrystalline structure. The ion implantation by La is primarily contribute to the adherence of oxide scale and the contribution of alloy surface treatment to the alloy is also essential for the effectiveness of internal to external oxidation transition to form a continuous oxide (Cr_2O_3) layer.

Electrical resistivity

Table 3: The electrical resistivity of the implanted and unimplanted specimens

Specimens	Electrical Resistivity (Ωcm)		
900 ^{0}C	1000 ^{0}C	1100 ^{0}C	1100 ^{0}C
Implanted			
SPS800	119.55	122.25	207.05
SPS900	119.7	124.7	208.18
HP1000	119.78	124.8	211.93
FC-4	145.8	146.05	224.18
Unimplanted			
SPS800	119.9	122.4	211.15
SPS900	120.15	124.93	217.55
HP1000	120.22	125.65	216.85
FC-4	146.65	146.2	225.57

According to the [10], the data for electrical properties of interconnect is typically evaluated by the area specific resistance (ASR). From the Table 3, it can be seen that the FC-4 materials have highest ASR values because the formations of oxide scale at the interface with the alloy. If compared the SPS800 and SPS900 samples show lower ASR values compared to the HP1000 sample. La implantation sample showed lower ASR values than unimplanted sample. That is caused of the reactive element effect, because the element improves the oxidation resistance of alloy and the formation of caution defects in the chromia scale, increasing subsequently the conductivity of the scale. In this study $Fe_{80}Cr_{20}$ alloys SPS800 after 100 h at below 1100 0C posses the lowest ASR values which is still much lower than the ASR limit values that the interconnect should posses and expected to be suitable as interconnect SOFC material.

CONCLUSION

The new process of this research is combining the multi process consist of ball milling process, hot compaction, spark plasma sintering and surface treatment via ion implantation. It indicated that this process produce good electrical resistance, good microstucture and good in high temperature oxidation for SOFC application.

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Darwin Sebayang
Faculty of Engineering Technology, University Tun Hussein Onn Malaysia
Parit Raja, Batu Pahat, 86400 Johor, Malaysia
darwin@uthm.edu.my (+607-4537794)

Asraf Othman
Center for Diploma Studies, University Tun Hussein Onn Malaysia
Parit Raja, Batu Pahat, 86400 Johor, Malaysia
ashraf@uthm.edu.my (+607-4538605)

Maizlinda Izwana[a] & Dafit Feriyanto[b]
Faculty of Mechanical and Manufacturing Engineering
University Tun Hussein Onn Malaysia
Parit Raja, Batu Pahat, 86400 Johor, Malaysia
izwana@uthm.edu.my (+607-4538555)[a]
dafitferiyanto@yahoo.co.idd (011-230373-68)[b]

Deni S. Khaerudini4,e,
[4]Kawasan Puspiptek Serpong Tangerang, Indonesia 153000
seadick2000@yahoo.com (+81 80-4519-6601)

Hendi Saryanto5,f
[5]Jl. Perumahan Wisma Harapan Blok B.8 No.38, Priuk, Tanggerang, Banten, Indonesia.
mesin01@yahoo.com (+6281-76607576)

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Change Agent System in Lean Manufacturing Implementation

Norani Nordin & Rabiha Asnan

ABSTRACT

Lean manufacturing have been widely used by manufacturing companies worldwide. However, low rate of success towards lean manufacturing transformation in many countries had created a cause of concern. Many publications has pointed out one of the reasons for the underperformance is primarily due to misunderstanding of the real concept and purpose of lean manufacturing. Therefore, change agent system is a crucial element in lean transition. The system is to assist the translation of lean manufacturing concept and purpose so that it could be understood by all people in the organization. This study in which this paper is based has reviewed the role of change agent system in lean manufacturing implementation. This study suggests that internal staffs are ultimately the best people to deliver the change to lean manufacturing system in an organization. This review will further expand the body of knowledge by bridging the role of change agent system and lean manufacturing implementation. This study will be significant both theoretically and practically especially those who lead the lean change projects to have the skills, competencies, and aptitude to assist the implementation of lean manufacturing system.

Keywords: lean manufacturing, change agent system, change management, team development.

INTRODUCTION

Lean manufacturing is not a new concept. In the past decades, the concept has progressed from technical oriented to human oriented. The human elements in lean manufacturing share the destiny relations and team-work which include labour flexibility, multi-skill and greater responsibility in maintenance, quality improvement and personnel issues (Oliver, Delbridge, & Lowe, 1998).

From the year 2000, the lean concept has been involved to a greater degree of contingency and the scope has been enlarged to include the organisational learning perspective. Some analysts such as Hines *et al.* (2004) and Jorgensen *et al.* (2007) believed that lean concept has a greater chance to progress and mature in future. The evolution can be likened to organisational learning which take place through a phased process. Shah and Ward (2007b) believe lean manufacturing is a multi-facet system. The integrated nature of lean system includes both people and process components. It is also related with the firm (i.e. internal), and supplier and customer components (i.e. external). Liker *et al.* (2004) in his analysis on Toyota, identifies that lean operates on two main principles: "continuous improvement" and "respect for people". Many senior managers outside Toyota has ignored and misunderstood the "respect for people" compared to "continuous improvement" (Emiliani, 2006). According to Angelis and Fernandes (2007) and Farris (2009),

lean manufacturing is rooted from kaizen or continuous improvement mindset which requires the skills and a shared way of thinking to systematically eliminating waste and improving activities' value. Therefore, the lean concept has progressed to a stage that includes the knowledge-creation management, which aim to create a learning organisation where people are the soul of lean process (Liker & Meier, 2005; Osono, Shimizu, Takeuchi, & Dorton, 2008; P. Stewart, 1998).

The misunderstanding of real concept and purpose of lean manufacturing is one of the main barriers of lean manufacturing implementation. Herron and Braiden (2007) and James (2006) suggest that the reason of this misunderstanding is due to cultural differences that occur during transition or translation of lean concept during the implementation. The misunderstanding on the concept leads to various major issues such as piecemeal adoption of lean tools and techniques (James, 2006), misapplication of lean tools (Herron & Braiden, 2007; Pavnaskar, Gershenson, & Jambekar, 2003), and lack of lean culture development that support the lean manufacturing in the organization (Jorgensen, et al., 2007).

There has been little scientific study and research done on the mechanism involved in the change agent system in lean manufacturing implementation and the effect of these mechanism have on existing manufacturing system. The role of change agent is crucial in lean transition. According to Stewart (2001), lean change agent must be sensitive to change issues. The reasons are most of the employees are not familiar with lean work environment, and it requires a behavioural and mindset change due to the different expectation for performance and value. Therefore, this paper attempts to investigate the role of change agent in lean manufacturing implementation. The primary focus is to explore the connection between change agent system and lean manufacturing systm.

LEAN MANUFACTURING SYSTEM

Many organizations in all industries and sectors around the world have been trying to adopt lean principles to create more values for customers and optimizing the resources. Lean is a management philosophy focused on identifying and eliminating waste throughout a product's entire value stream, extending not only within the organization but also along the company's supply chain network(Scherrer-Rathje, Boyle, & Deflorin, 2009).Lean manufacturing which was originated from The Toyota Production System (TPS) was developed in Japan by Ohno during 1950's. The Toyota Production System was based around the desire to produce in a continuous flow which did not rely on long production runs to be efficient but it was based around the recognition that only a small fraction of the total time and effort to process a product added value to the end customer(Melton, 2005). Shah and Ward (2007a) define lean as "an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability". While Worley (2004) defines lean manufacturing as the systematic removal of waste by all members of the organization from all areas of the value stream. The value stream is the activities that contribute to the transformation of a product from raw material to finished product including design, order taking, and physical manufacture (J.P Womack & Jones, 1996).

According to Shah and Ward (2003), the core thrust of lean manufacturing is to create a streamlined high-quality system that produces finished products at the pace of customer demand with little or no waste. Waste specifically means any activity that absorbs resources but creates no

value(Chauhan & Singh, 2012).There are seven types of waste to be reduced by an organization applying lean principles which are overproduction, inventory, conveyance, correction, motion, processing, and waiting (Ohno, 1988).The lean concept is not a single-point invention, but the outcome of a dynamic learning process(Holweg, 2007). It is important to understand lean as more than tools. The 8 principles of lean are Identification of value, Elimination of waste, Generation of flow (of value to the customer), Identifying customer defined value, Optimizing the value stream, Converting the value flow smoothly by controlling and eliminating wastes, Activating the demand pull by synchronizing customer demand and information flow and Perfection of all products processes and services (J.P. Womack & Jones, 2003; James P. Womack, T.Jones, & Roos, 1990).The benefits of implementing Lean Manufacturing are highly significant. Typical benefit's of 'lean' are reduce lead time, less rework, financial saving, increased process understanding, reduce inventory and less process waste(Melton, 2005). Furthermore, it can incorporate less human effort, maximizing productivity and enhanced quality(Forza, 1996; Karim & Arif-Uz-Zaman, 2013).

CHANGE MANAGEMENT

Change Management is closely connected with all project processes and functions, which are exposed to changes: scope, time, cost, quality, risk, contract/procurement, human resources, communications and other key integrative processes; and it functions is to solve problems of project protection from the influence of external and internal change factors, introduce all necessary changes and control the process of changing(Voropajev, 1998). Diefenbach (2007) stated that change is exactly all about changing structures, processes, routines and outcomes, changing how people do the business, how they think and act, and changing (parts of) schemata and worldviews of people.

Change agent system

One variable that has been strongly linked to the success of a change project is the existence of a change champion, a member of the organization, who acts enthusiastically to have the idea implemented (Howell & Higgins, 1990). The fundamental components of a champion's capacity to introduce innovations successfully are the articulation of a compelling vision of the innovation's potential for the organization, the expression of confidence in others to participate effectively in the initiative, and the display of innovative actions to achieve goals(Howell & Higgins, 1990)

A change agent can be considered as an internal and external individual that is responsible for initiating, sponsoring, directing, managing or implementing a specific change initiative, project or complete change programme (Caldwell, 2003). Lee et al.(2010) stated that change agent is a person chosen to cause organizational change.

People resist change because they feel more comfortable and secured being in their immediate environment. The main reason is due to their individual resistance which are fear of the unknown, belief that change is not good for the organization and fear of losing something value (Robbin, Decenzo, & Coulter, 2010). Within a change programme, it is essential to remove the fear and anxiety in order to obtain the trust needed. There are few necessary roles for being a successful change agent. Schein (1997) indicated the role as:. being supportive; dealing with the realism of the situation; accepting lack of knowledge; seeing change as intervention; offering support;

recognizing problems belong to them; not being prescriptive; learning from each intervention; involving people in the problem; and looking for resolution. Additionally, Buchanan and Boddy (1992) have listed competencies of effective change agents as clarity of specifying goals, team building activities, communication skills, negotiation skills and "influencing skills" to gain commitment to goals.

Everyone in the organization have to recognize a need for change. Massey and Williams (2006) suggested that in order to achieve this awareness they are required to scan their immediate workplace and they must agree their work area needs for change and start discussions on how to make the process and the job easier to perform. During this process the change agent acts mainly as a negotiator between team members and identifies the appropriate resources required for the project(Massey & Williams, 2006). The change agents have to interact with various types of "clients" to support change within their organization and it is Importance for them to understand the clients and the reasons for the desired change (Schein, 1997).

Pamfilie et al. (2012) suggested that first of all, they have to understand the change that occurred which requires a good communication, employee's motivation for facing the project challenges and also well trained managers. Change agent development was very closely linked to management support because good change agents were sometimes held back when the management was unsupportive(Herron & Hicks, 2008).Although change in itself means uncertainty, managers are expected to generate clear and adequate formulation of what the problem is and where they would like the organization to be(Saka, 2003).Beside demonstrating commitment and leadership, top management must also work to create interest in the implementation and communicate the change to everyone within the organization. Through their involvement, employees are encouraged to contribute to the change which will take place and which will bring all benefits for all of them, thus feeling more confident both in their own abilities and their work capacity and also in the organization in which they operate, developing their creativity and innovation (Pamfilie, et al., 2012).

CONNECTION BETWEEN LEAN AND CHANGE AGENT

The change to lean manufacturing system is a radical process and not an easy task (Ahlstrom & Karlsson, 1996; Smeds, 1994). In order to create the foundation for lean manufacturing to take hold, a significant organisational change must occur within the organisation. According to Narang *et al.* (2008), the process of lean transition requires significant changes in the functions of the company.

Ballé (2005) believes that many failures in the attempts to implement lean start with a fundamental misunderstanding of how to acquire lean. Robbin et al.(2010) proposed that Education and Communication is the key to reduce resistance to change due to misunderstanding. Many researchers have discussed the problem and barrier in lean implementation. One of the main problem is lack of a clear lean understanding (Behrouzi & Wong, 2011; Nordin, Deros, & Wahab, 2011; J. M. Worley & Doolen, 2006) **.** Ichimura et al.(2007) revealed that despite the high percentage of companies (91 per cent) considering Lean to be important, disappointingly, 64 per cent felt that the workers did not have the right understanding of Lean and 55 per cent did not have a Lean training programme. While from the result of the study done by Worley and Doolen (2006), there was a strong evidence that dissemination of information to all employees about

lean manufacturing did not occur. They have found that the executive management team and the area leads appeared to understand the concept of lean manufacturing, but the employees did not receive sufficient information. Without workers' good understanding of Lean Manufacturing, it is not likely that company achieve effective Lean Manufacturing operation(Ichimura, et al., 2007).

Change agents are important links in that learning process (Heijden et al. (2012). Change agents should incorporate different ways to interact and exchange information between people from different departments, in order to engage all the people in the organization (Heijden, et al., 2012). People communicate with others in their organisation to reduce the number of possible interpretations, and in doing so make coordinated action possible (Eisenberg, 2006).Cultural and resistance issues have to be dealt and addressed during the early lean journey. Boyle et al.(2011) found that there is a number of cases plant managers were "let go" due to their resistance to lean and their inability to lead the cultural changes required for lean. Losonci et al. (2011) revealed that the awareness regarding the importance of managing employees during the lean conversion is not new but less attention is given on the human aspect such as what employees actually perceive, think and feel about the lean implementation. Without commitment, the perceptions of employees regarding change can be affected by belief. Armenakis et al. (2007) stated that the recipients' beliefs especially in the need for change, in the appropriate corrective action, and in the change agent will influence the success of organizational change initiatives.

In lean manufacturing implementation, the change agent system can be initiated either from internal cross-functional team or external consultant team. According to Bhasin (2012), there exists a need to recognize that ultimately the best people to deliver any cultural change are the internal staff .Therefore the change agent should had a higher level of lean manufacturing knowledge and skill than that of the person receiving the training. (Herron & Hicks, 2008).The change agents may be senior line managers and often chief executives or those specifically charged with managing the processes of organisational development (OD) and cultural change in the organization to play the role that implements change (Lee, et al., 2010; Saka, 2003). In addition, according to Real *et al.* (2007) , and Bamber and Dale (2000), team building is the key factor for successful plans of action. For effective change, a strong team with a strong leader should be developed. Study on the role played by change agents in the transfer of lean manufacturing techniques discovers that without the support of management the lean transformation in a company will fail even though the change agent have the determination for effective intervention (Herron & Hicks, 2007). Real *et al.*(2007), and Herron and Hick (2007) agreed that the support of consultant also contribute in initiating lean transformation. The main objective of this system is to spread the motivation and ensure the translation is understood by all people in the organisation for the change to lean manufacturing system. However, entirely depending on external consultant is not advisable for the long-term success of the organisation. Bamber and Dale (2000) found that as the consultant left the company, the effort to lean is faded away. This is because the lean activities were entirely driven by the consultants. Consequently, no fundamental change in mind-shift and commitment to lean is transferred to the employees if it is driven by the consultants.

Effective implementation of lean manufacturing mainly depends on commitment from management at the top level and the total involvement of staff at all levels within the firm(O'hEocha, 2000) . Managers will be expected to lead the changes needed for lean success, and therefore their knowledge of lean and commitment to it will influence how well an innovating culture enables lean success(Boyle, et al., 2011).The commitment of management and the ability of change agents

are the key determinants of success that help companies to improve productivity through applying lean manufacturing(Herron & Hicks, 2008). Lean commitment is captured by the allocation of an industrial engineer for change, employee training, ensuring a sufficient number of employees are available to undertake lean improvement activities, providing employees time for learning and testing new techniques and processes (i.e. learning and testing), committing the necessary monetary investments , and providing active supervisory management support (Boyle, et al., 2011).

It is important for the managers to not only focused in narrowing their knowledge of lean but need to increase their knowledge in management as well. Boyle et al.(2011) realized that more support for lean improvements can be seen and there's evidence of the company moving from simply implementing individual lean practices to lean thinking if greater management exposure to the current management literature. In short, the main problems in lean manufacturing implementation are lack of lean understanding, lack of management commitment and lack of organizational communication. Therefore, the change agents are needed to overcome these entire barriers before and during lean implementation. The change agents should play their role in explaining the concept of lean manufacturing by providing enough information, communicate the benefit of lean at all level, and improves senior management commitment.

CONCLUSION

The role of change agent is crucial in lean transition. There has been little scientific study and research done on the mechanism involved in the change agent system in lean manufacturing implementation and the effect of these mechanism have on existing manufacturing system. Internal change agents and team development are the key factors that support the successful lean manufacturing implementation.

This paper has thoroughly discuss the integration of change agent system and lean manufacturing implementation through past literature analysis. Therefore, the future research will be developed a model that will serve as a basis of on-coming empirical study. A multiple case studies will be conducted for this purpose. Hopefully, the findings from the this research could to provide manufacturing firm's manager with a better understanding of the lean transition and a clear guidance to minimize the resistance and conflicts for the implementation of lean and thus improves its chance of success.

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Norani Nordin
School of Technology Managemant and Logistics
Universiti Utara Malaysia
06010 UUM Sintok, Kedah.
rani@uum.edu.my

Rabiha Asnan
School of Technology Managemant and Logistics
Universiti Utara Malaysia
06010 UUM Sintok, Kedah.
rabiha86@yahoo.com

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UniMAP PV Power System Trainer Set for Teaching and Standby Power Generator

T.M.N. Tunku Mansur, N.H. Baharudin, R. A,
A.R.N. Razliana & Z. Farhana

ABSTRACT

Energy from Sun represents an abundant resource, which radiates energy from the Sun at but only energy received at the outer atmosphere of Earth [12]. In theoretical, the energy from Sun could supply the world's energy demand. Solar energy in the form of photovoltaic (PV) is already popular in the countries around the world. Malaysia is one of the tropical countries generally received high solar radiation with an average per month [16]. It is shows that Malaysia has enormous potential of PV technology. The objective of this paper is to analyze the performance of UniMAP PV Power System Trainer which has been designed for commercialization. In addition, the characteristic of solar irradiance received in Perlis, Northern of Peninsular Malaysia also been analyzed.

Keywords: Solar radiation, UniMAP PV power system trainer.

INTRODUCTION

Environmental phenomenon, such as global warming and depletion of the ozone layer attributed to emissions from massive fuel combustion are slowly but surely causing widespread problems to every living thing on earth. In December 2009 at Copenhagen, Malaysia announced a conditional voluntary target of up to 40% reduction in carbon intensity of GDP by 2020, based on 2005 emission levels. Renewable energy, particularly photovoltaic technology is one very effective solution available today [1].

Solar energy is in the form of electromagnetic radiation with the wavelengths ranging from about 0.3μm (10^{-6}m) to over 3μm. Most of this energy is concentrated in the visible and the near-infrared wavelength range. The incident solar irradiance sometimes called insolation, is measured as irradiance, or the energy per unit time per unit area or power per unit area [4].

Solar energy is one of the most valuable sources of energy and the only single energy source that can supply an additional energy the world needed over the next several decades. Photovoltaic (PV) cells, modules and arrays allow the direct conversion of solar energy into electrical energy. The maximum efficiency of PV at around 9-12%, depending on the type of solar cells [2]. Malaysia is a tropical country and generally hot all year around and experiences its rainy season during the end of the year. The average solar energy received is between 1400 and 1900 kWh/m^2 annually with an average of 12 hours of sunshine daily [12]. In general, Malaysia one of the countries has high potential in solar electricity generation, the present initiatives and efforts are lower than the country's actual potential.

The amount of solar radiant energy falling on a surface per unit area and per unit time is called irradiance. Solar radiation measurements are one of the important to most engineering application. It is used for the design, sizing, performance evaluation and research of solar energy application. In this paper, the main focus is study the PV power system trainer which is specially designed by the School of Electrical System Engineering.

EXPERIMENTAL SETUP

The instruments used to collect and record the irradiance is Davis Vantage Pro2 Weather Station. This weather station data has successfully installed at the top of a 10 m height from the ground at Centre of Excellent for Renewable Energy (CERE). This weather station used to collect and record solar irradiance, temperature, wind speeds, wind directions, pressure, humidity and rainfalls data. Data was transmitted through the wireless system and downloaded using the software in one minute interval for 24 hour operation. Then, the data was manually saved every day to keep maintaining the data collection. For analyzing daily temperature and solar radiation, the data is observed on 7.00 am to 7.00 pm to obtain the minimum, maximum and difference of temperature and also taken the average solar radiation.

The PV power system trainer consist of a PV module, solar charger, 1200 watts of power inverter, 12V battery and other accessories can be assembled and connected to its rack-stand for a complete PV trainer module. The PV power system trainer is illustrated in Figure 1.

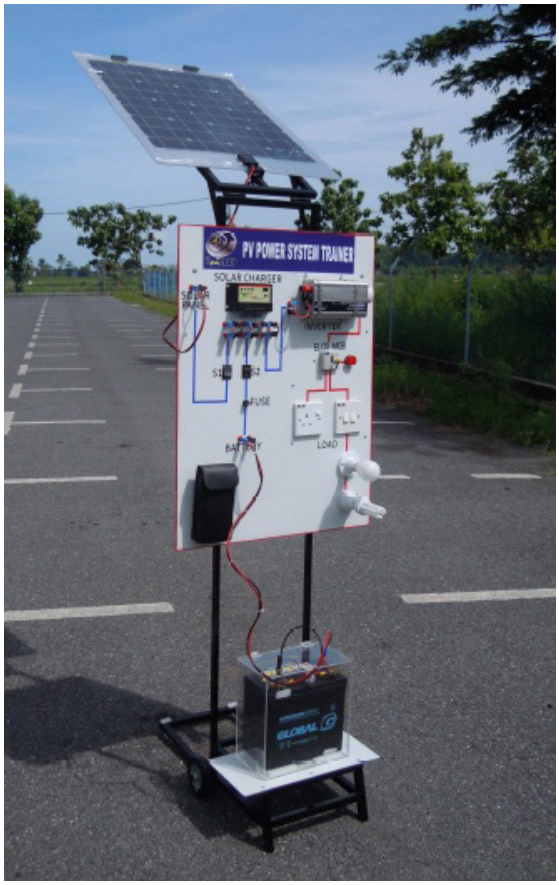

Figure 1: PV power system trainer

The PV power system trainer used the 50 watts of PV module. This trainer is specially designed at low cost compared to the commercial trainer. The PV module can be flipped up and down for easy carrier. The trainer is suitable for uses in PV Power System courses where participants will be able to have hands-on experience of the system, hence, increased their understanding. Figure 4 shows the outdoor training that has been done in a few days for data collection. The type of PV module used in this system was polycrystalline due to low costing and suitable for Malaysia climate. Figure 4 shows the block diagram of a standalone PV power system.

Figure 2: Compact and easy to carry

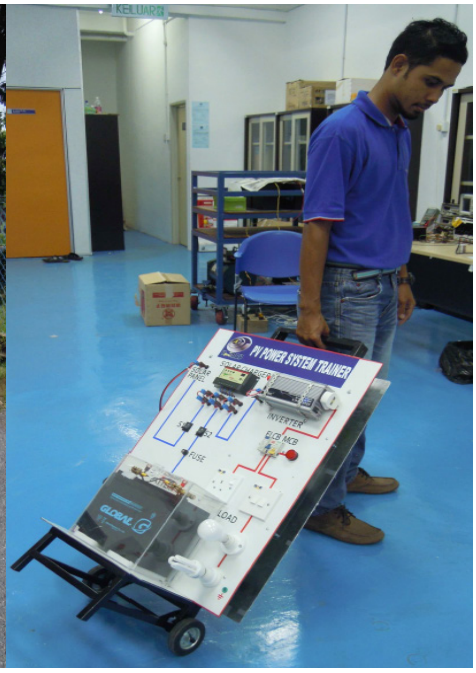

Figure 3: Outdoor training

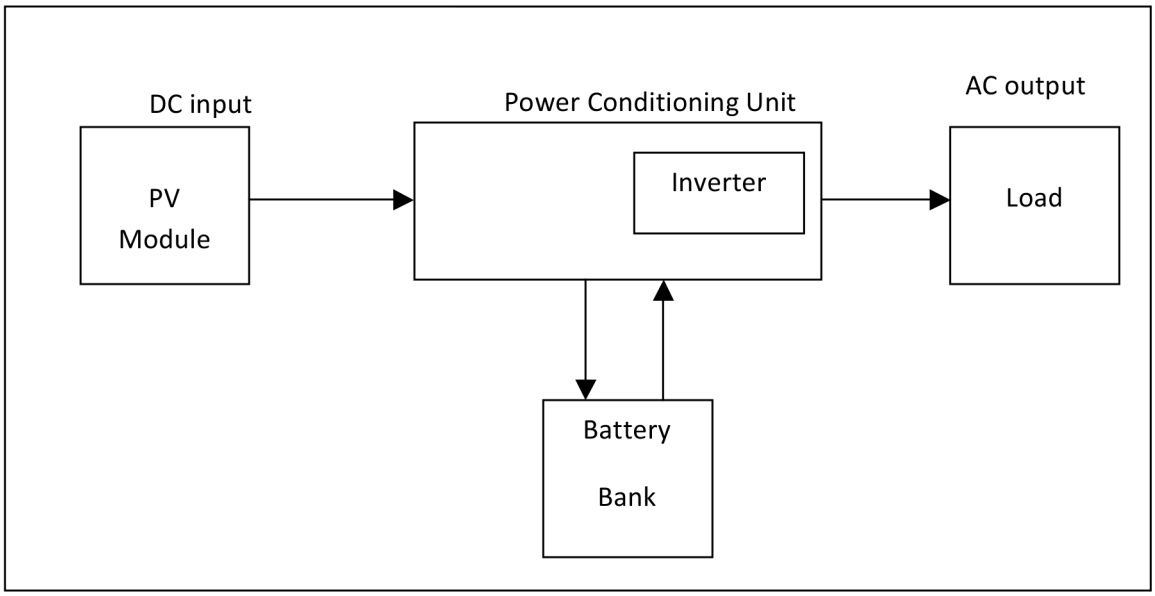

Figure 4: Block diagram of a standalone of a PV power system

The PV power system consist three parts that are DC input, power conditioning unit and AC output. The power conditioning unit consist of a charger controller and inverter. The charge controller is important in this system to charge and keep the battery from overcharging. The AC output is in single phase 240 Vac. The PV power system trainer is protected by a 20A current fuse. The test of a PV power system trainer was conducted in one day duration.

During the observation to record the generated amperes and voltages over the PV module, the variable resistor has been used. The data were recorded every minute by using PM 300 power analyzer. In order to find the output current and voltage for this solar panel, the optimum value of the resistance needs to find first. From the calculation by using this formula $P=I^2R$ the optimum value of these types of PV module is 5.5 Ω. To find the output current, the variable resistor is connected in series with the PV module while for the voltage output performance the connection of the variable resistor has been set up in parallel with the PV module.

RESULT

Daily Solar Radiation

The data were captured and recorded from the beginning of March 2011 until the end of May 2012. Through these years, the maximum solar radiation receives is 6.76kWh/m^2 with ambient temperature 31.07°C and mostly in November and March. The minimum solar radiation receives about 0.45kWh/m^2 with ambient temperature 23.69°C in May. Compared with these results obtained in the research, sometimes measured temperature at the output is quite low with higher solar radiation.

According to the Figure 3, the total solar radiation from March 2011 to May 2012 was found to be 2089.7426 kWh/m^2 with the maximum contribution occurring during March and November. It goes higher during the Northeast monsoon period which during this monsoon period, the wind blows from central Asia to South China Sea through Malaysia and move on to Australia. The lower solar irradiance occurs between May to September during the Southwest monsoon. At that time, the wind blew from Australia across the Sumatra Island and move to the strait of Malacca. As shown in Fig. 4.2 day 290 which is in October 2011, the patterns of solar irradiance recorded are scattered from 3.13 kWh/m^2 to 4.91 kWh/m^2. These phenomena occurred due to the transition period from the Southwest Monsoon to Northeast Monsoon.

During the transition period also known as intermonsoon period, the daily solar irradiance recorded is lower than the average value. Although Malaysia does not have four seasons, but it is still affecting the variation of solar irradiance by the changes of monsoon.

Measurement of PV Power System Trainer

In this section, the experimental result of the PV Power System Trainer performance was measured and recorded by using PM 300 Power Analyzer. This trainer is loaded by 5.5Ω of variable resistor to obtain the current, voltage and power produced by it. Battery is the critical equipment for these systems since it is a standalone system. For the battery system, voltage and current from the PV module is important to ensure the battery can be charged and time to fully charge.

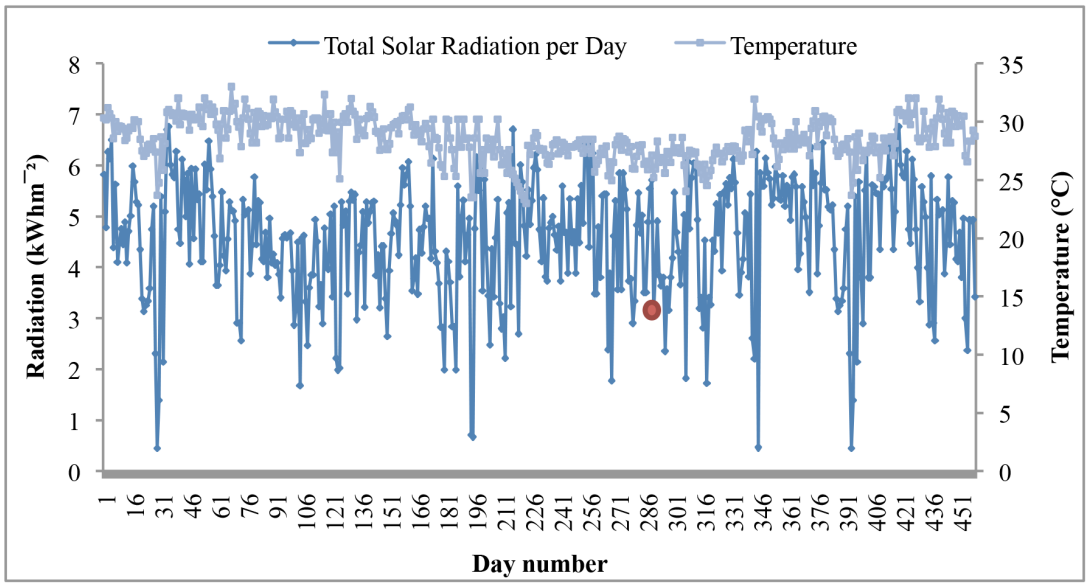

Figure 5: Relationship of solar radiation and mean temperature (March 2011-May 2012)

The test has been done during the sunny day and the variation of solar irradiance is shown in Figure 4.The solar irradiance is integrated over all daylight hours. The curve seems to be perfectly fitted the real data in the morning, and the deviation of the curve started increasing after 7 am. It shows that the maximum solar irradiance recorded is from 11 am until 4 pm. Solar irradiance increases proportionally with the time until it reaches the maximum and then begins to decline from evening until night. The characteristic of solar irradiance may affect the performance of PV trainer.

The result of PV Power System Trainer is showed in Figure 5, 6 and 7.It is showed that the highest power produce by the trainer is between 10 am until 4 pm. At this time, the solar irradiance is in the highest level. This is because, at that time, 90% of the extraterrestrial radiation becomes direct radiation while the rest are being deflected as diffuse radiation.

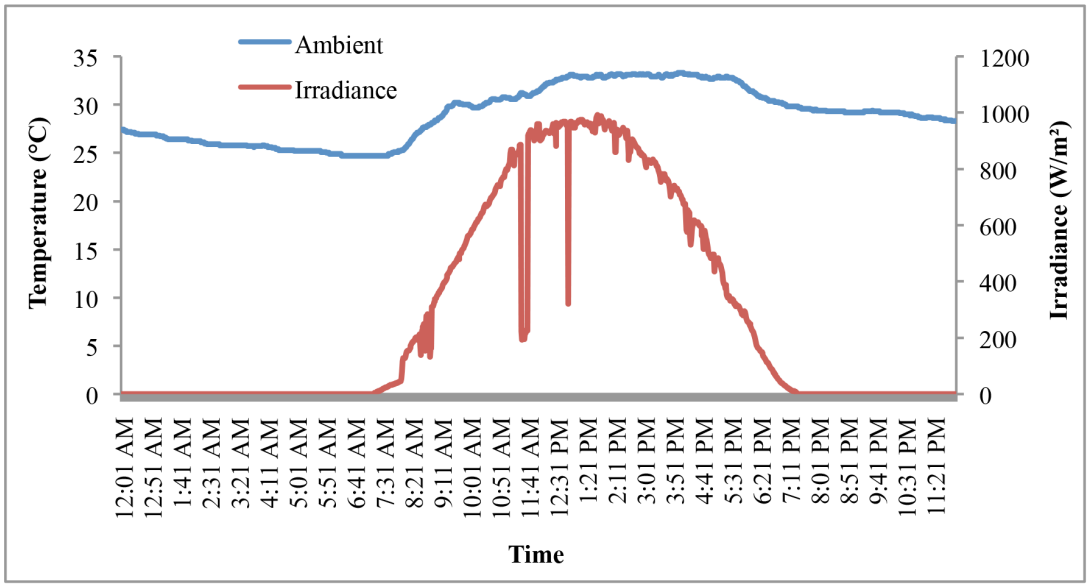

Figure 6: Solar irradianceand ambient temperature for the whole day.

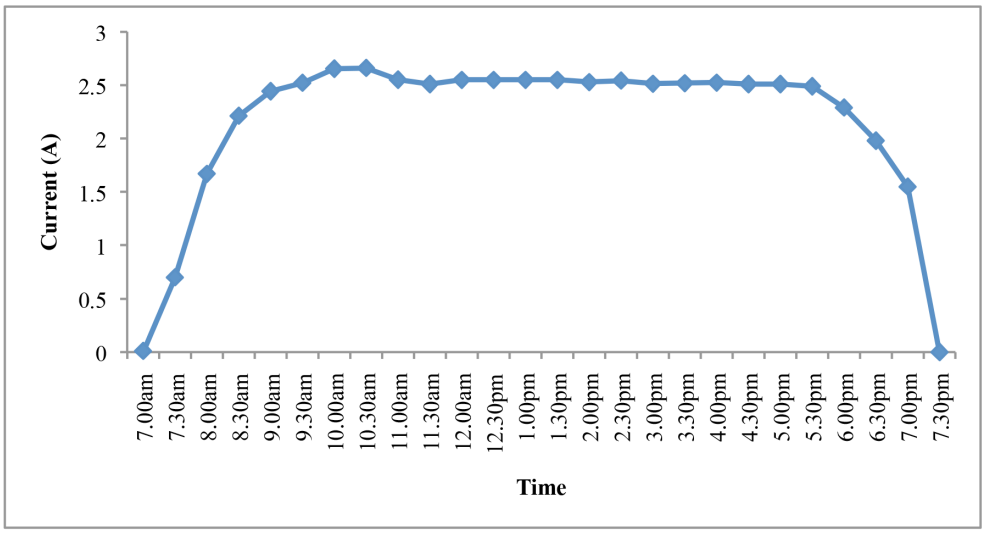

Figure 7: PV trainer current in a function of time.

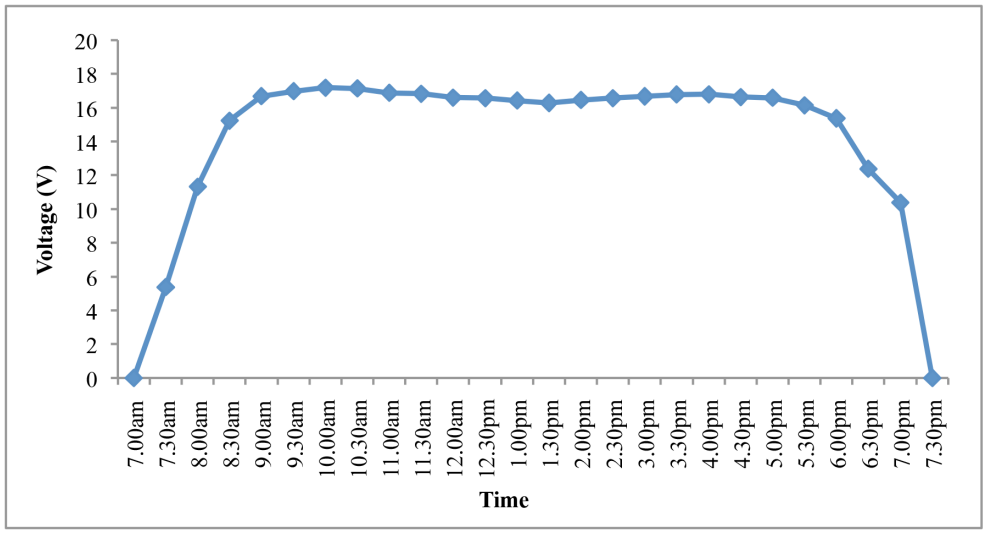

Figure 8: PV trainer voltage in a function of time.

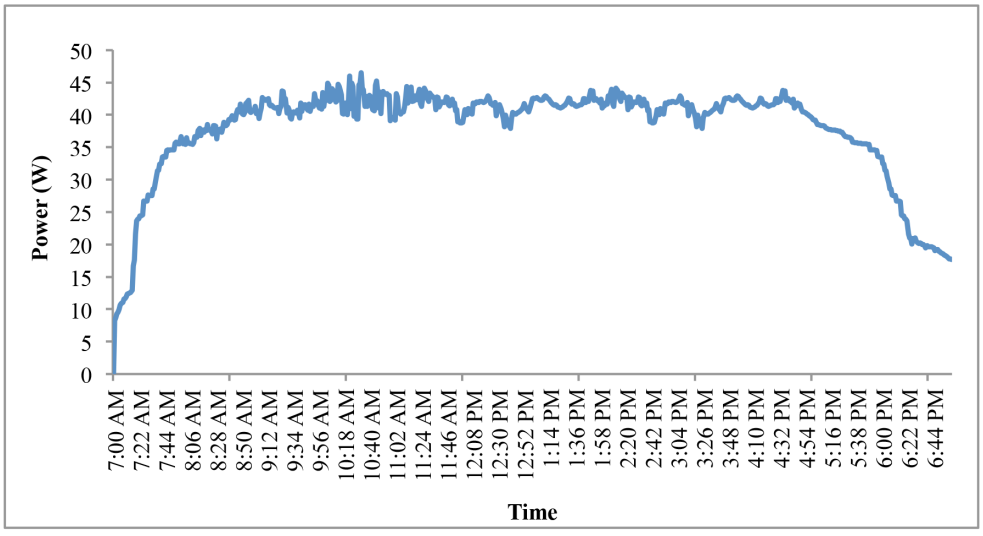

Figure 9: PV trainer power in a function of time.

The main concept of PV Power System Trainer is standalone PV Power System. The installation complete with individual components of PV power system. This would make the PV Power System Trainer easy to understand very suitable to use in teaching, training or even in research purposes. In addition, it could also function as standalone power supply for small loads. This trainer is categorized as standalone system and it is physically compact and easy to carry.

CONCLUSION

The PV Power System Trainer is presented in this paper. Under the given load demand, this PV trainer work properly. This product is specially designed by the School of Electrical System Engineering at a low cost compared to the commercial product. Besides, this product is small, lighter, portable and make it easy to store.

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T.M.N. Tunku Mansur
N.H. Baharudin
R. A, A.R.N. Razliana
Z. Farhana
School of Electrical System,
Universiti Malaysia Perlis,
02600 Arau Perlis
tunkunizar@unimap.edu.my

ICT, Teknologi dan Kejuruteraan

Jilid ini menghimpunkan makalah yang terpilih untuk dibentangkan dalam Seminar Hasil Penyelidikan Sektor Pengajian Tinggi ke-3, 2013 yang berlangsung di EDC, Universiti Utara Malaysia pada 2 & 3 Julai 2013. Makalah yang termasuk dalam jilid ini meliputi pelbagai cabang ilmu dalam kluster ICT, Teknologi dan Kejuruteraan. Kajian-kajian yang dibentangkan dalam seminar ini dijalankan menggunakan pelbagai dana penyelidikan yang dibiaya oleh Kementerian Pengajian Tinggi yang kini menjadi Kementerian Pendidikan.

KU RUHANA KU MAHAMUD mendapat ijazah sarjana muda dalam sains matematik dan jazah sarjana dalam pengkomputeran, dari Universiti Bradford, United Kingdom dalam tahun 1983 dan 1986. Beliau memperolehi ijazah kedoktoran dalam bidang sains komputer dari Universiti Pertanian Malaysia pada 1994. Beliau kini seorang profesor di Pusat Pengajian Pengkomputeran, Kolej Sastera dan Sains, Universiti Utara Malaysia. Penyelidikan beliau tertumpu kepada permodelan prestasi sistem komputer dan pengoptimuman koloni semut. Buku beliau, *Pengaturcaraan C* memenangi anugerah penerbitan terbaik dalam kategori buku akademik pada tahun 1999. Pada 2002, beliau menerbitkan sebuah lagi karya berjudul *Matematik untuk Perniagaan.* Beliau juga adalah ketua editor *Journal of Information and Communication Technology* dan editor bersekutu untuk beberapa jurnal lain.

MD NAJIB IBRAHIM adalah Profesor di Jabatan Seni Gunaan dan Senireka, Universiti Islam Antarabangsa Malaysia. Pada masa ini Sr. Md Najib adalah ahli Majlis Pertubuhan Juruukur DiRaja Malaysia dan Penilai dan Pemeriksa Luar Program Master of Engineering Technology - Green and Energy Efficient Building, sebuah program usahasama Universiti Kuala Lumpur dan University of Applied Science Rosenheim, Germany. Kerjaya beliau bermula di Universiti Teknologi Malaysia pada tahun 1976. Jawatan terakhirnya sebelum bersara pada 2004 ialah Profesor Seni bina beliau. Selama tempoh itu beliau telah menyelia lulusan-lulusan PhD dalam seni bina dan kejuruteraan elektrik. Md Najib mempunyai latar belakang akademik merentas bidang iaitu sarjana muda fizik dari Universiti Kebangsaan Malaysia, sarjana sains Architectural Engineering dari Pennsylvania State University dan PhD Architecture dari University College London. Beliau adalah Fellow Pertubuhan Juruukur DiRaja Malaysia dan mantan ahli penuh American Society of Heating Refrigerating and AirConditiong Engineers (ASHRAE) dan Illuminating Engineering Society of North America. Beliau telah diundang oleh Kementerian Pendidikan dan beberapa universiti sebagai ahli penal penilaian penyelidikan dalam bidang sains gunaan, kejuruteraan, pembinaan, warisan dan sains sosial. Beliau juga pernah dilantik sebagai pemeriksa luar program ijazah sarjana muda dan diploma ukur Universiti Teknologi MARA selama 5 tahun.

AHMAD KAMAL IDRIS adalah profesor dalam kejuruteraan petroleum di Universiti Teknologi Malaysia. Prof. Ahmad Kamal mulanya memperoleh sarjana muda dan ijazah sarjana dalam bidang kejuruteraan petroleum daripada Institut Teknologi Bandung pada 1978 dan 1980. Beliau kemudian menyambung pengajiannya di peringkat kedoktoran dalam bidang yang sama di Imperial College of Science, Technology and Medicine, University of London, United Kingdom pada 1990. Antara bidang pengkhususan ya meliputi enhanced oil recovery, emulsion and demulsification of crude oil–water system, microscopic oil-water displacement, pembelajaran dan pengajaran dalam pendidikan tinggi dan pembangunan kurikulum.

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